5 JANUARY 1961

ONE SHILLING AND SIXPENCE

ELECTRICAL TIMES

-5 JAN 1961
HIGH STREET, LONDON, W.

The 'ENGLISH ELECTRIC'

WEATHERBEATER

provides a self-contained indoor 33 kV substation with the economies of an outdoor installation.

Easy erection • Simple foundations • Less land required
Interchangeability of moving portions • Integral earthing
Complete weather protection • Speed and ease of isolation
Good operation and maintenance facilities
Pleasant appearance

'ENGLISH ELECTRIC'

THE ENGLISH ELECTRIC COMPANY LIMITED, ENGLISH ELECTRIC HOUSE, STRAND, LONDON, W.C.2
Switchgear Department, Stafford
SGS 34A WORKS: STAFFORD · PRESTON · RUGBY · BRADFORD · LIVERPOOL · ACCRINGTON

5 JANUARY 1961 ELECTRICAL TIMES

More advantages

in Mark II SNAP-LOCK heavy duty limit switches

A TYPE APPLICABLE TO EVERY INDUSTRY

WATER OIL AND DUSTPROOF OR FLAMEPROOF VERSIONS

Now

TWO ONLY REPLACEABLE UNITS IN THE ELECTRICAL SIDE

There are only two assemblies in the electrical side of B.S.A. ACME SNAP-LOCK Mk. II limit switches: a moulded one-piece contact block and the contact arm. Interchangeable on all models they are designed for easy replacement. Service kits comprising these items, complete with holding nut and fixing screws, are supplied at moderate cost.

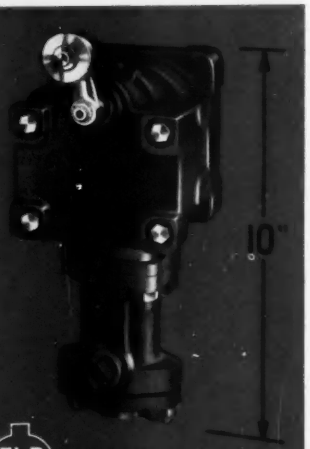
B.S.A. Acme Snap-Lock heavy duty limit switches have an established reputation for reliability under the most arduous conditions. Recently introduced Mark II versions retain proved features of their forerunners but incorporate refinements in design and manufacture principally to simplify servicing, provide complete interchangeability of assemblies, increase electrical resistance to earth and ensure lasting efficient sealing. Please ask for the Mark II catalogue.

STANDARD

WATER, OIL & DUST PROOF

Single pole, double break, double throw, operates with either circuit normally open with other closed, or maintaining in either position, or available with central (neutral) position and/or centre connection. Heavy aluminium die-cast case. Water, oil and dust proof. Conduit ¾ in. B.S., or No. 3 Admiralty Pattern Cable gland entry. Two-screw side mounting or backplate mounting in two styles, or Tandem style (back to back mounting). Operating lever position adjustable in 7.5 deg. increments through 82.5 deg. either way from normal.

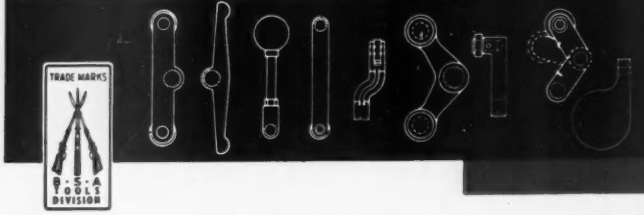
STANDARD NEUTRAL POSITION OR CENTRE CONNECTION



FLP FLAMEPROOF

SINGLE OR DOUBLE ENTRY

Buxton certificates No. 3574 (Group I) No. 3575 (Groups II and III gases). Meehanite iron castings. Self wiping solid silver contacts, interchangeable plugs and sockets. Internal mechanism removable as a unit for servicing. **Single SWA cable entry (standard); double entry if required.** *Operating lever position adjustable in 7.5 deg. increments through 360 degs. Single pole, double break, having one normally closed and one normally open circuit. Available with central (Neutral) position and/or centre connection.*



A few examples from the range of more than 30 styles (over 150 sizes) of interchangeable operating levers. List on request.

TRADE MARKS
B.S.A. TOOLS DIVISION

Made in England under Licence by B.S.A. TOOLS LIMITED, BIRMINGHAM 33

Sole Agents U.K.

BURTON GRIFFITHS & COMPANY LIMITED

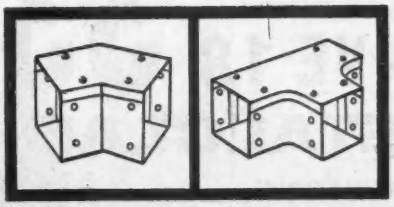
SNAP-LOCK DEPT., MONTGOMERY STREET, BIRMINGHAM, 11

PHONE: VICTORIA 2351

B.S.A. SNAP-LOCK ACME

463

Power Centre trunking fittings. Precision made Speeds the job of installation. Layout extension or alteration made easy Shown right, H.E.T. Half Normal Bend and Normal Tee.



it's what you don't see that makes Power Centre Trunking so durable

ELECTRICAL DIVISION

POWER CENTRE

Poor J.B., he's been hanging around for days. Never said a word to anyone. Doc says it's trunking problems. "He needs a tonic", he said. So Doc, who gets to the bottom of everyone's troubles, prescribed Power Centre, the people who make jig made trunking that's got a hidden coating of zinc which ensures long lasting protection. This P.C. treatment has re-vitalised J.B. Already, he's feeling on top of the world with the satisfaction of knowing he can cut installation costs by as much as 33⅓%.
J.B. is a different person now, thanks to Power Centre. What's more, he fully recommends a dose of P.C. to anyone who's suffering from trunking problems.

If you're in this unnecessary predicament, take the first step to satisfaction by sending for P.C.'s fully descriptive literature.

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P.O. BOX 18, LLOYD STREET,
WEDNESBURY, STAFFS.
Telephone: Wednesbury 1311

Stocks in all Simplex Branches throughout the country and the world.

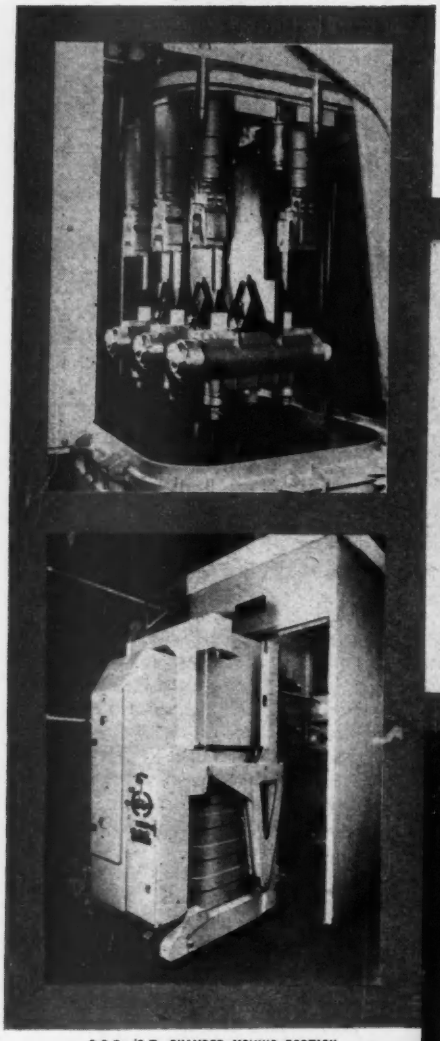
HI-VE 18 33kV OUTDOOR METALCLAD SWITCHGEAR

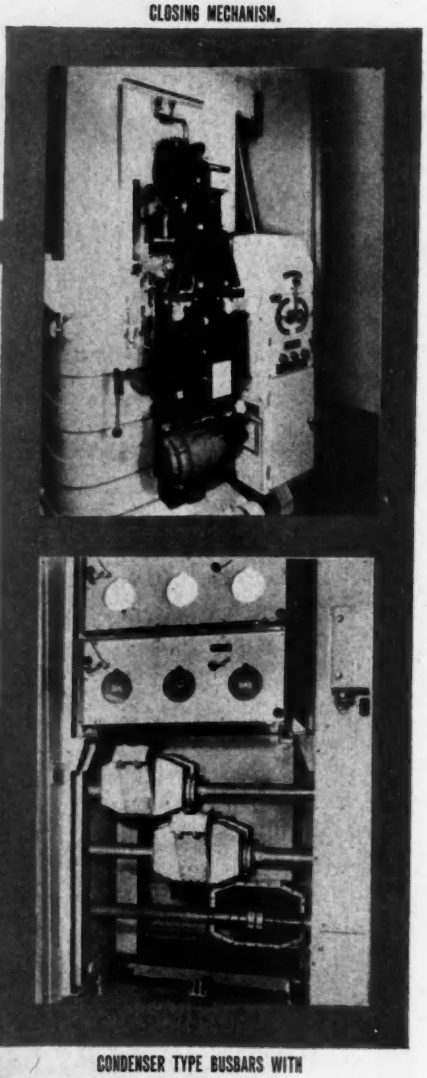
OUTSTANDING HIGH-PERFORMANCE 1,000 MVA O.C.B.

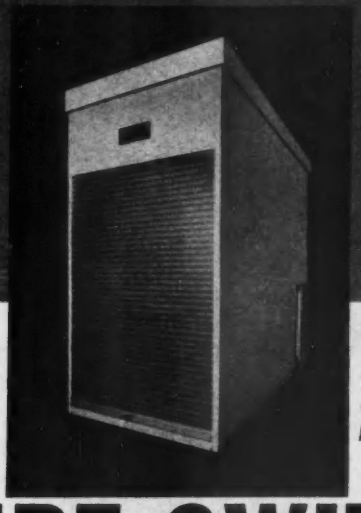
ADVANCED DESIGN FEATURES

FULL MAINTENANCE POSSIBLE WITHIN OUTDOOR HOUSING.

HYDRAULICALLY ACTUATED O.C.B. CLOSING MECHANISM.







O.C.B. /C.T. CHAMBER MOVING PORTION ELECTRO-HYDRAULICALLY OPERATED.

CONDENSER TYPE BUSBARS WITH TEE-OFF JUNCTION BOXES.

A COMPACT SELF CONTAINED WEATHERPROOF UNIT ON 5′ 9″ CENTRES.

YORKSHIRE SWITCHGEAR

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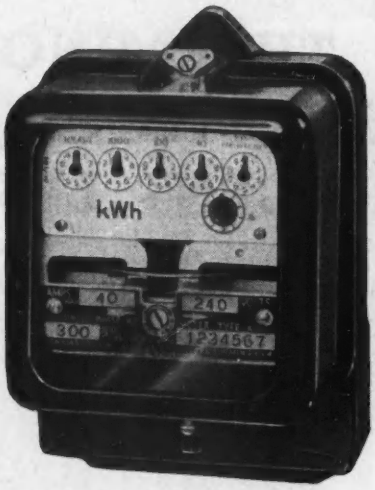
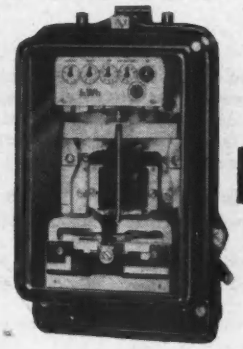
MEANWOOD, LEEDS 6, ENGLAND. TEL: 57121/5



TYPE K
SINGLE PHASE



TYPE KT
3 PHASE
3 WIRE

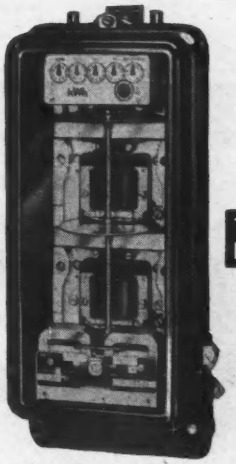
C & H

"K" Series of Meters

TYPE KTAC
3 PHASE
3 WIRE.
PRECISION
PATTERN
WITH
"FLICK"
CONTACTOR

Please apply to us for appropriate Catalogue Sections covering this "K" series of meters

TYPE KP
SINGLE PHASE—
PREPAYMENT PATTERN



TYPE KT4
3 PHASE
4 WIRE

Chamberlain & Hookham Ltd.

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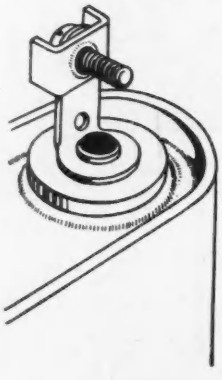
Hunts THERMINOL CAPACITORS FOR FLUORESCENT LIGHTING

A new range of foil and paper capacitors to meet the exacting requirements of the Fluorescent Lighting Industry, Hunts Therminol Capacitors incorporate the following important features :—

- **Impregnated and filled with a specially developed non-inflammable oil.**
- **Safe and entirely reliable operation in ambient temperatures of up to 70°C.**
- **Housed in oval shaped extruded aluminium cans.**
- **Seam-welded lids which form no exterior ridge, giving increased operating efficiency with reduced dimensions.**
- **If required, a screw and "U" clamp can be fitted at extra cost. (See diagram).**

★ *As streamlined as the tube itself.*



SPECIFICATION

Test Voltage:
Capacitors. Up to and including 250 volts A.C. = Wkg volts x 2
above 250 volts A.C. = Wkg volts x 2.5
D.C. Test = A.C. Wkg volts x 3
To Earth, A.C. wkg volts + 1,000 volts A.C. or 2,000 volts A.C. min
Sealing Test: Each Capacitor is heat tested at 80°C
Capacitance Tolerance: Standard limits as shown. Others by arrangement
Power Factor: Better than 0.3% at working volts at 30°C

TYPE L89/1 STANDARD RANGE

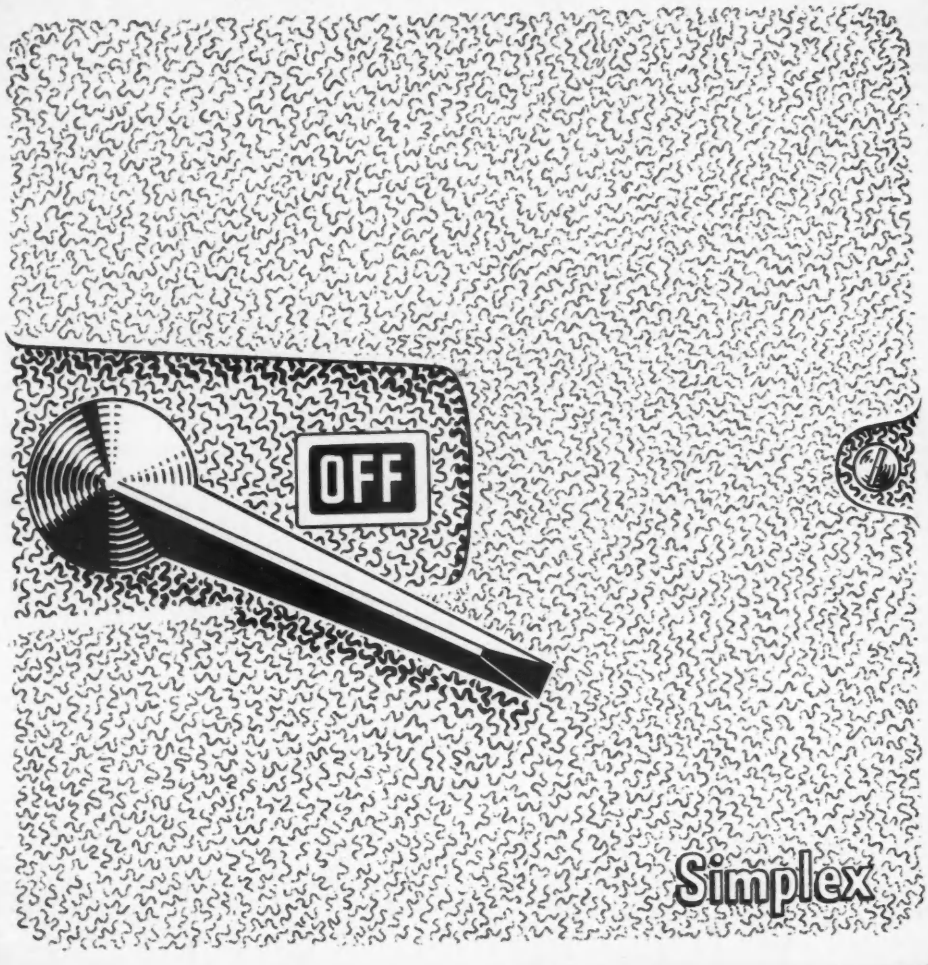
Capacitance μF	Volts A.C. wkg.	List No.	Dimensions—inches	
			Length	Cross section of all units
3.2 min	250	ZG101	2	2.148 x 1.398
4 min	250	ZG102	2½	
5 min	250	ZG103	2⅝	
6 min	250	ZG104	3	
7.4 min	250	ZG105	3½	
3.5±5%	400	ZG106	3¾	
6.8±5%	400	ZG107	5⅜	

REGISTERED TRADE HUNTS MARK CAPACITORS

MAKERS OF FIXED CAPACITORS for all RADIO, ELECTRONIC and ELECTRICAL POWER USES, DRY ELECTROLYTIC — METALLISED PAPER — FOIL and PAPER — SILVERED MICA — STACKED MICA — CERAMIC — TRANSMITTING TYPES, etc., etc.

A. H. HUNT (Capacitors) Ltd., Electrical Division, Vulcan Way, New Addington, Croydon, Surrey. **Telephone:** Lodge Hill 2661-4.
Head Office: Bendon Valley, Garratt Lane, Wandsworth, London, S.W.18
Factories also in Essex, Sussex and North Wales

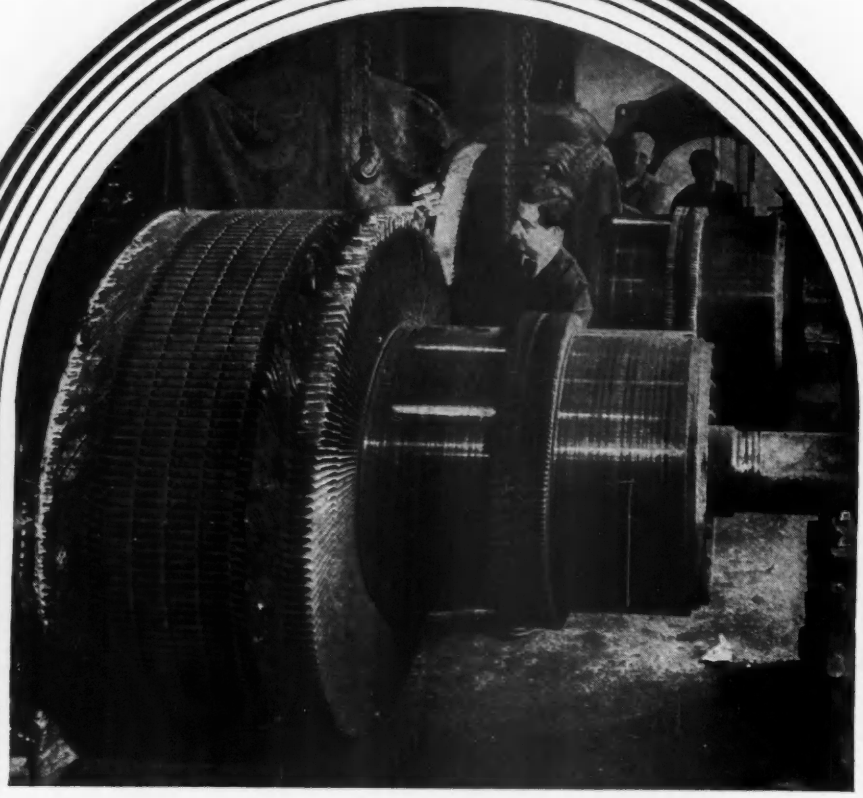
Simplex Switchgear



Star Switchfuses and Busbar Chambers → Page 7

Star Distribution Fuseboards → Page 9

Simplex Switchboards → Pages 10, 11



Engineers' Language! For every Plant Engineer who swears at Collins, there are ninety-eight and a quarter who swear by them. Engineers being engineers, this is quite something. As we were saying, we show two 1500kW 240-volt 600 r.p.m. D.C. Generators, one being stripped out for rewinding, t'other being rewound.

COLLINS

Collins Electrical Ltd.
Head Office 115 *Clerkenwell Road London EC* 1
Central London Works
22 *St. Albans Place Upper Street Islington N* 1
West London Works
9 *&* 11 *Featherstone Road Southall*
Phone Holborn 0212-4 *Canonbury* 3227-8
or Southall 0168

simplex star switchgear

SWITCHFUSES AND BUSBAR CHAMBERS

Simplex were one of the first to develop a complete range of front operated switchgear. The advanced design is: remarkably simple to install and maintain · low in price, and completely safe. They are available in 15, 30 or 60 amp fuse ratings, 500 volt A.C. or 250 volt D.C. The Busbar Chambers are available in 600 volt, 200, 400, 600 and 800 amp ratings · are readily extendable · have a high through-fault capacity · universal clamp connections — no drilling — no sweating. More details of Simplex Star Switchfuses and Busbar Chambers on request.

SIMPLEX ELECTRIC COMPANY LTD.
CREDA WORKS, BLYTHE BRIDGE
STOKE-ON-TRENT, STAFFS
Branches throughout Britain and
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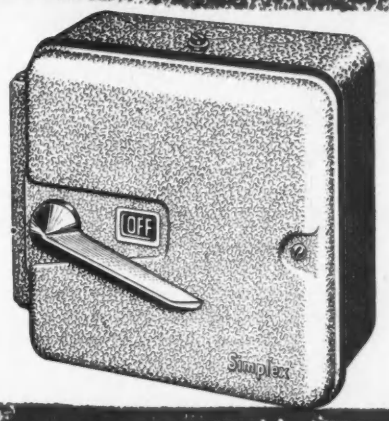
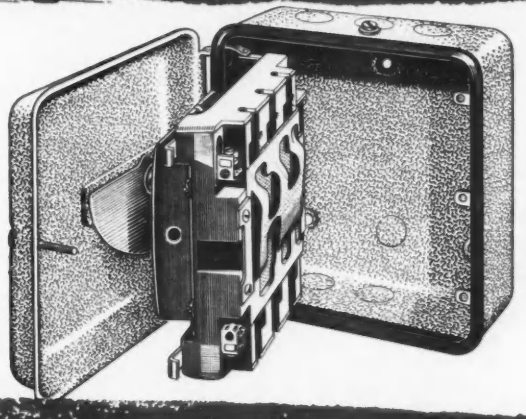
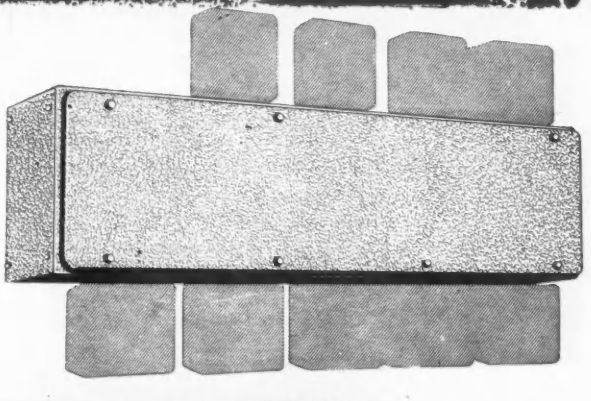
ELECTRICAL DIVISION



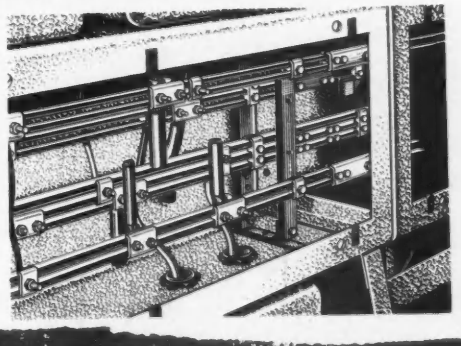
Simplex Star Switchfuse. Strong pressed steel case. Superbly styled.



Star Switchfuse with cover open showing interior hinged forward for ease of wiring.



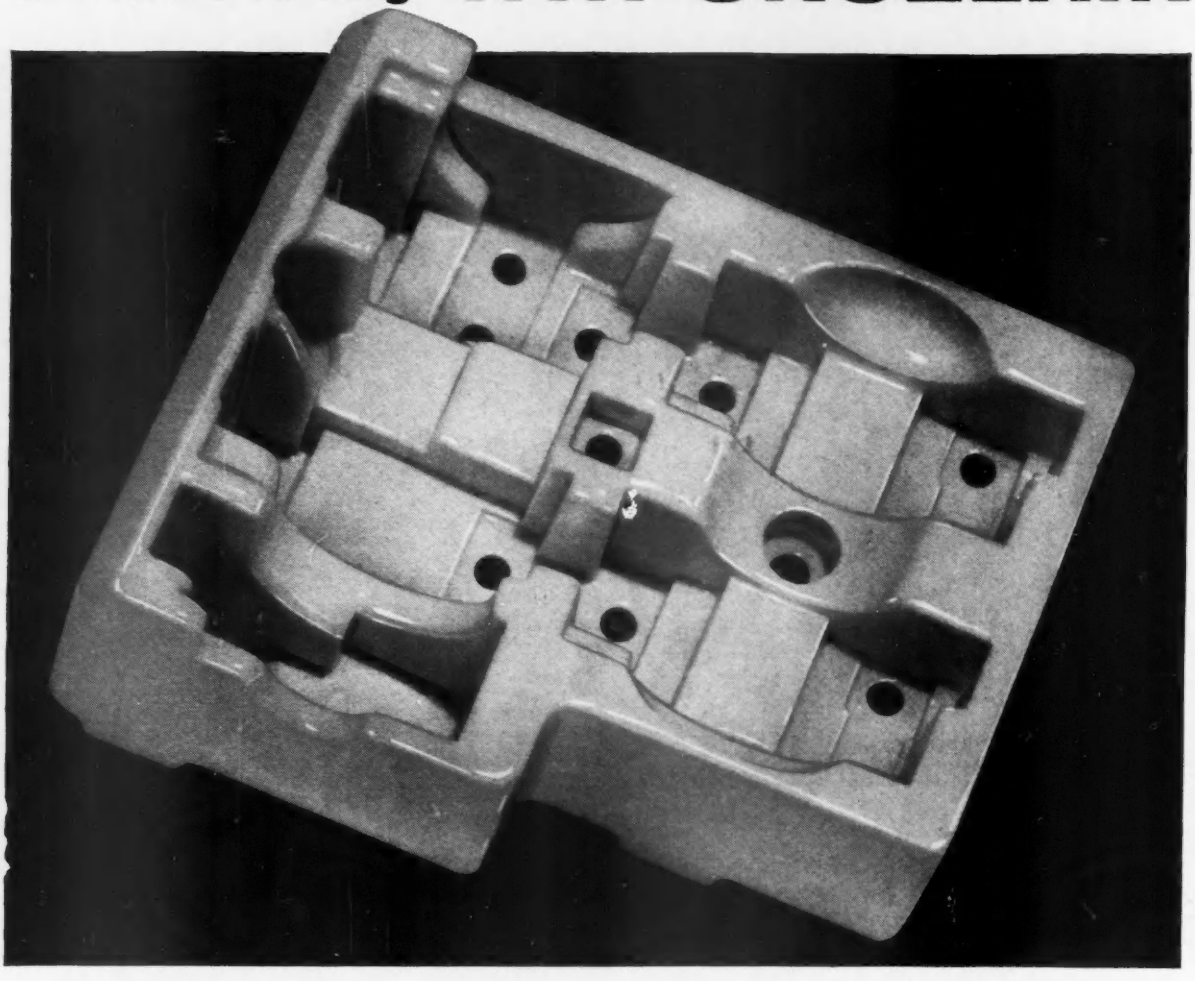
Star Busbar Chamber.



Close up of interior of Star Busbar Chamber showing main branch terminals, and busbar arrangements.

Cables cut away for purpose of illustration

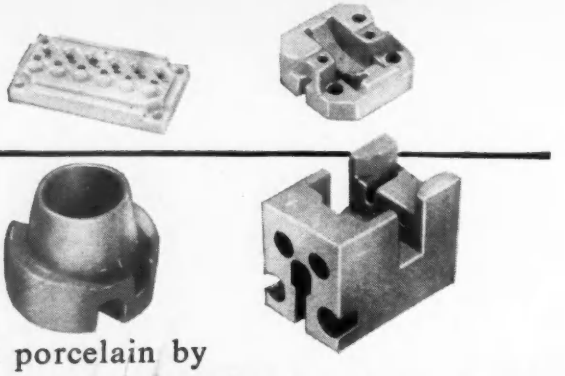
It's safe to say T.T. PORCELAIN



This is an intricate die-made porcelain insulator manufactured to a customer's specification. It set many problems of design and manufacture, and close tolerances demanded precision and know-how at every stage of production.

But these problems are daily routine at Taylor Tunnicliff. This insulator is typical of thousands made each day in our three large factories. Porcelain, still the world's best insulating material for this class of work, is safe in our hands.

May we examine your insulation problems for you?



Perfection in porcelain by

TAYLOR TUNNICLIFF & CO., LTD

Head office: EASTWOOD · HANLEY · STOKE-ON-TRENT · *Tel:* STOKE-ON-TRENT 25272-5
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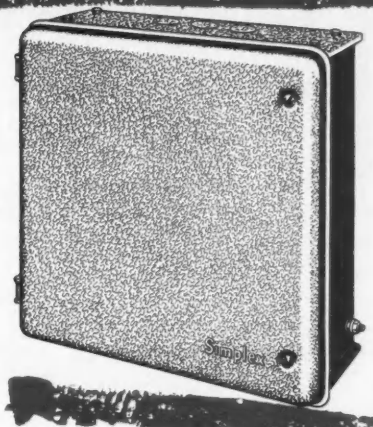
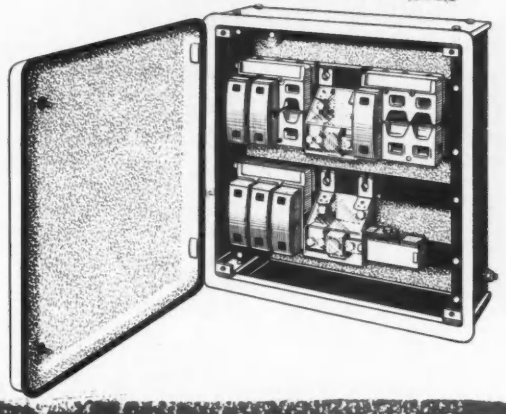
Simplex Star Switchgear

DISTRIBUTION FUSEBOARDS

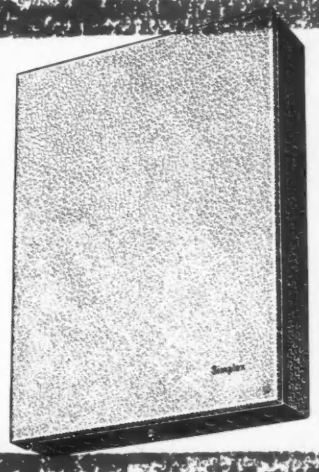
Simplex Star "dead-front" Distribution Fuseboards are: low in price · easy to wire · completely safe because all live parts are shrouded, even with the fuses removed. There is provision for; circuit indentification on the fuse bank and neutral connections · surface or flush mountings, Ratings — 15, 30 or 60 amp, 500 volt A.C. or 250 volt D.C. Star Economy Distribution Fuseboards offer the same advantages as the Star Distribution Boards at the lowest possible price. More details of Simplex Star Distribution Fuseboards available on request.



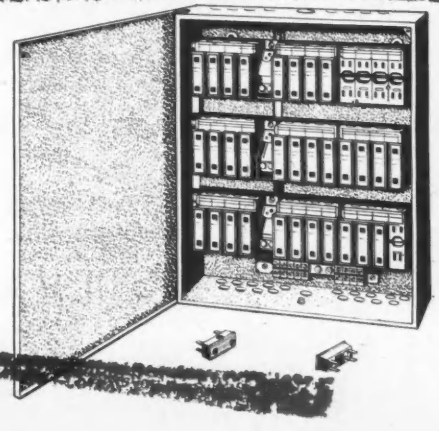
Star Distribution Fuseboard. Neat appearance. Strong All-Steel case.



Star Distribution Fuseboard with cover open; some fuses are removed to show dead-front feature.



Star Economy Distribution Fuseboard.

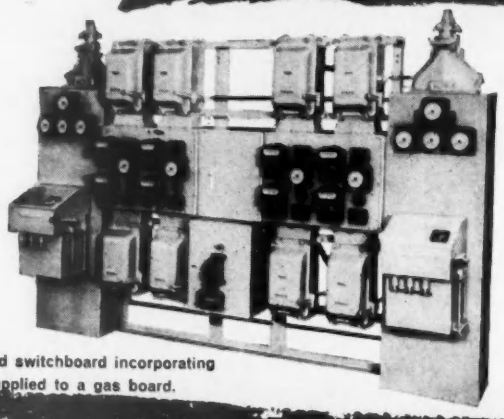


Star Economy DistributionFuseboard with cover open showing shields, and dead-front feature when fuses are removed.

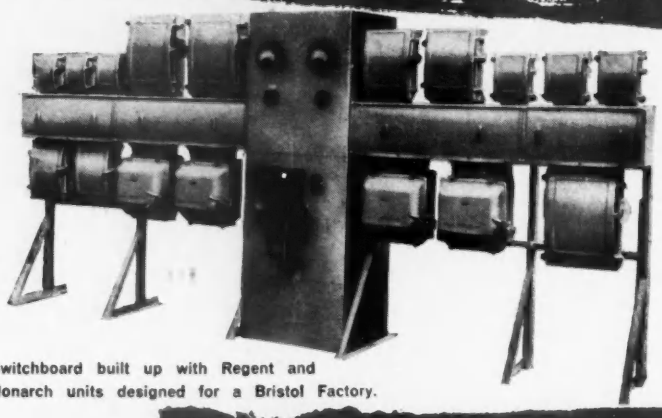
SIMPLEX ELECTRIC COMPANY LTD.
CREDA WORKS, BLYTHE BRIDGE
STOKE-ON-TRENT, STAFFS
Branches throughout Britain and Agents throughout the World

ELECTRICAL DIVISION

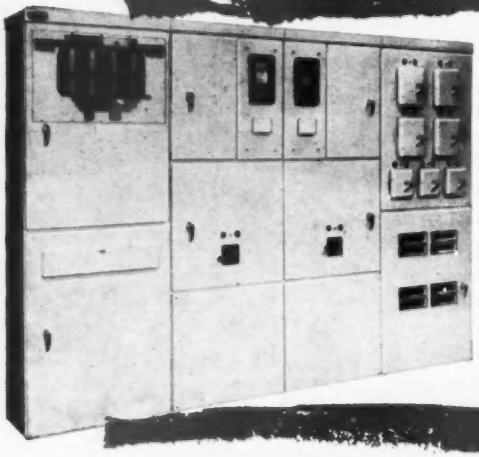
Simplex switchboards



Specially designed switchboard incorporating Monarch units supplied to a gas board.



Switchboard built up with Regent and Monarch units designed for a Bristol Factory.



Cream coloured cubicle type switchboard, incorporating mimic diagram of floor-warming circuits, made up of Star and S & S installation switches controlling all electrical services at a dock's reception area.

Multi-tier Regent switchboard with Monarch incoming unit for an international airport.

Simplex leadership stems from vast experience, sheer technical efficiency and a team of brilliant designers who are constantly setting new trends for the industry

SIMPLEX ELECTRIC COMPANY LTD.
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STOKE-ON-TRENT, STAFFS
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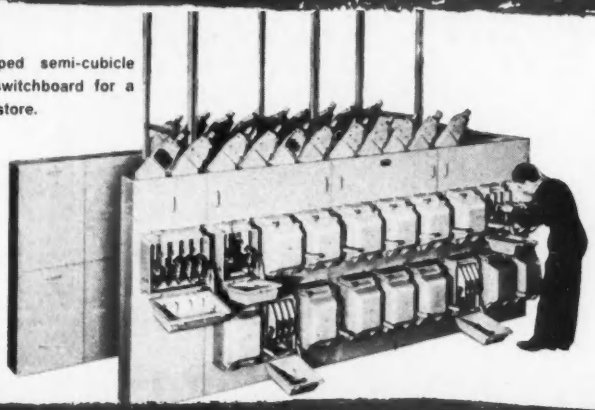
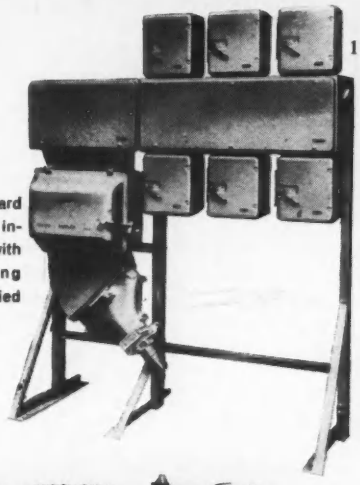
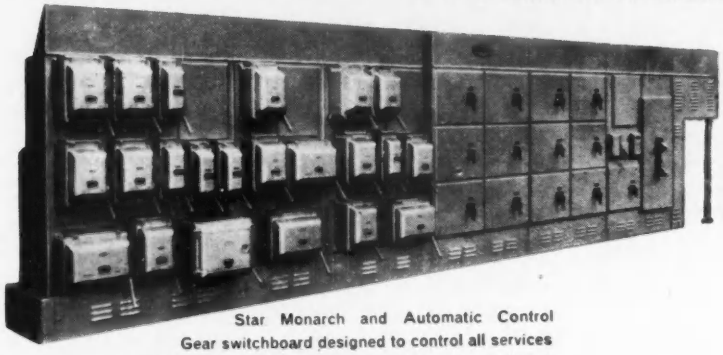
ELECTRICAL DIVISION (TI)



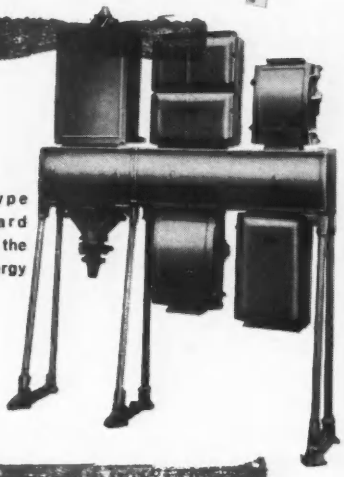
U-shaped semi-cubicle type switchboard for a large store.



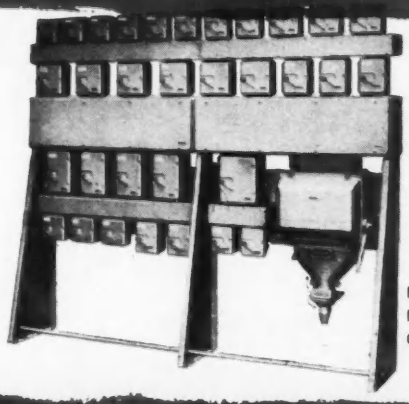
Star switchboard with Monarch incoming unit (with angled sealing chamber) supplied to a factory.



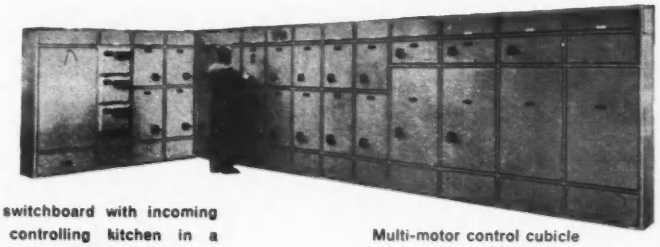
Star Monarch and Automatic Control Gear switchboard designed to control all services (and floorwarming) for a comprehensive school, Menai.



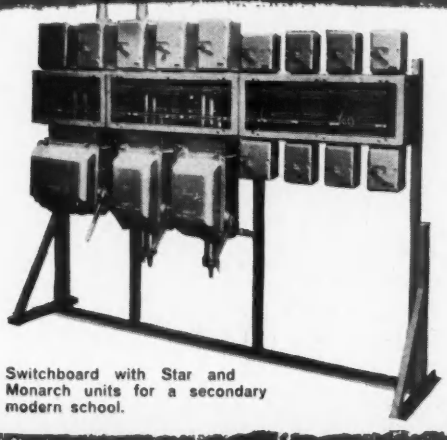
Regent type switchboard supplied to the Atomic Energy Authority.



Multi-tier Star switchboard with incoming Monarch unit controlling kitchen in a Commercial Building, Birmingham.



Multi-motor control cubicle for an oil storage installation, London.



Switchboard with Star and Monarch units for a secondary modern school.

Busbar mounted multi-motor starter-board for an oil refinery.

Typical two-tier arrangement of Regent switchboard, with Monarch incoming unit, supplied to a factory.

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tall orders for rising mains need BICC M·I·N·D

Mass-Impregnated Non-Draining

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The special impregnating compound developed by BICC for M.I.N.D. Paper Insulated Power Cables will not migrate, even when the cables are operating in vertical installations.

BICC Mass-Impregnated Non-Draining Cables are highly effective for use as rising mains in tall buildings, flats, offices, towers and deep mine shafts for all voltages up to 33 kV.

M.I.N.D. Cables eliminate compound migration troubles . . . they simplify maintenance . . . *and cost no more than conventional cables.*

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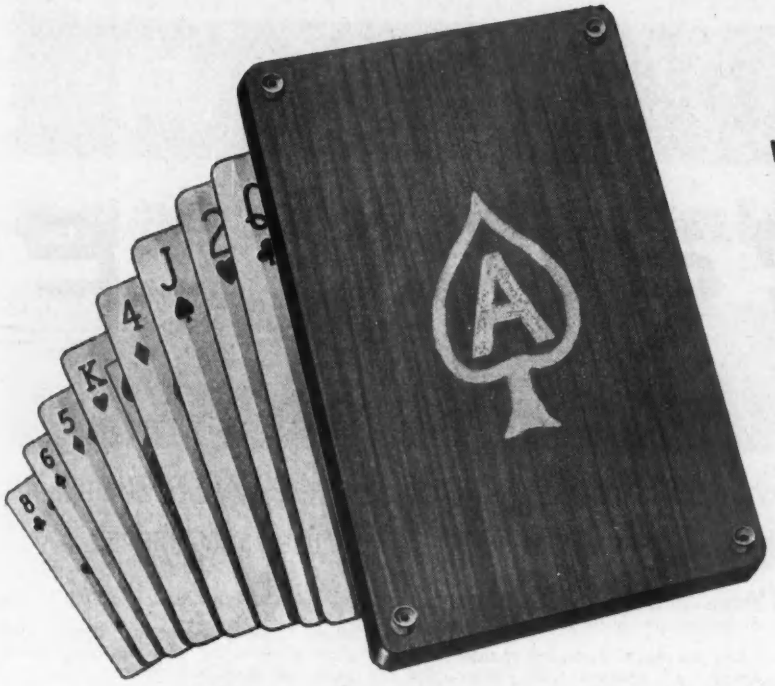

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Naturally . . . when they're Wootton-made . . . and Wootton-tested! They're made of the best plywood Wootton could lay hands on. Tested for reliability . . . toughness . . . durability. Wootton meter boards stand up to anything. Even in the most extreme climates. No contraction or expansion or warping with Wootton! Oh, and there's more to Wootton than just meter boards. They make wood blocks too, and instrument cases, and they're aces at sunk switch boxes.

WOOTTON–the meter board people

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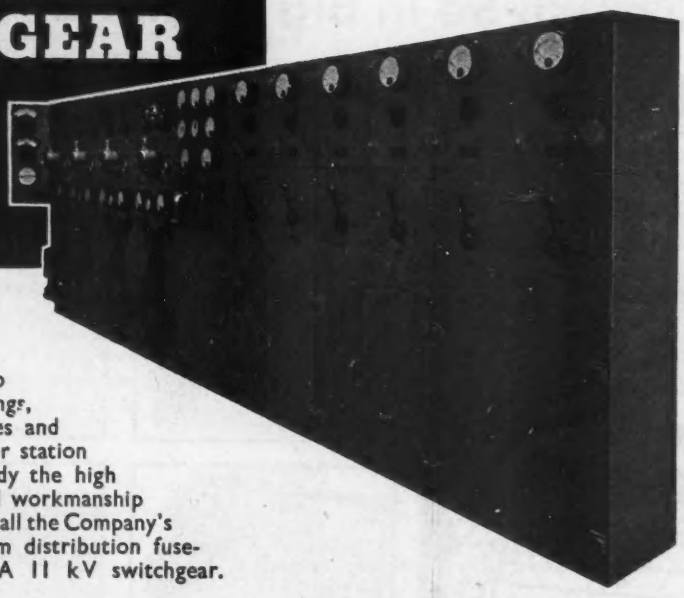
CUBICLE TYPE
SWITCHGEAR
MEDIUM VOLTAGE



Switchboards of this type have been supplied to hospitals, public buildings, banks, industrial premises and for the control of power station auxiliaries. They embody the high standard of design and workmanship which is to be found in all the Company's products ranging from distribution fuse-boards to 250 MVA 11 kV switchgear.

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streamlite

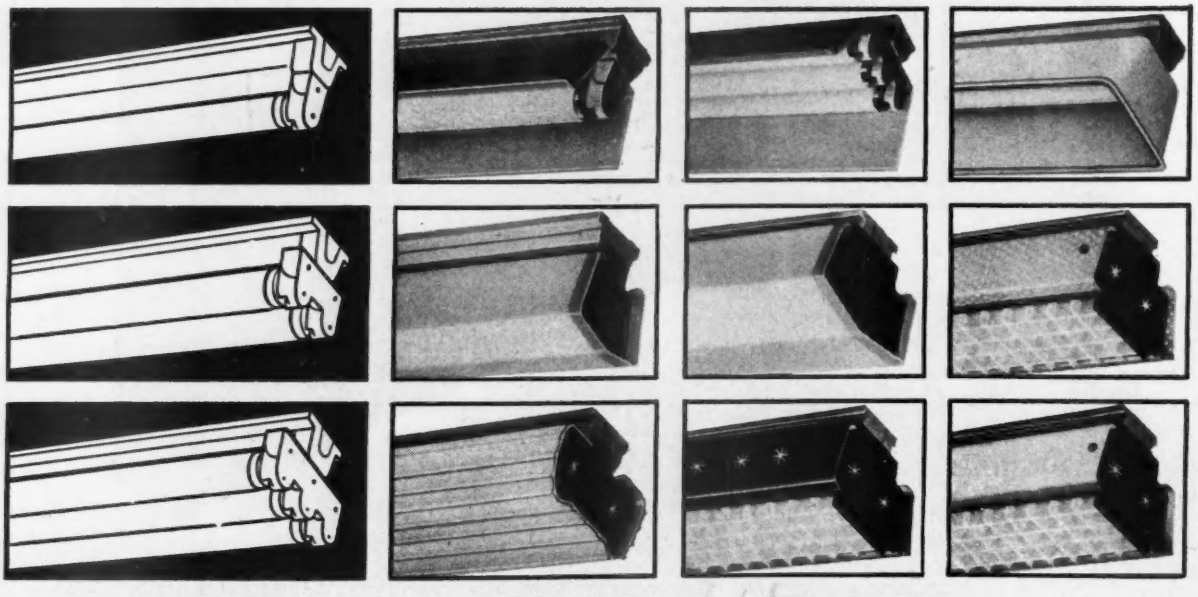
is here!

The newest, slimmest lighting fittings for 1, 2 and 3 lamps 5ft. 80w (1 & 2 lamps 2ft. 20w, 4ft. 40w)—with a big range of reflector and diffuser attachments

Philips Streamlite – it's the newest thing in fluorescent lighting fittings. And it outdates every other type of fitting on the market. For Philips Streamlite – so slim, so sleek, so stylish – has far more to offer than any other fluorescent fittings you can buy, including some advantages that are as unique as they are striking:

- *Philips Streamlite gives you Switch and Switchless start in the popular sizes.*
- *There is a choice of one, two or three lamp fittings – all equipped with Philips even slimmer Polyster ballasts.*
- *There is a fine range of diffusers and reflectors.*
- *It is extraordinarily reasonable in price.*
- *B.S. Box fixing and conduit entries at 24" centres. (B.S. 2467) 2 ft. 20w. 17½" centres.*
- *Variable fixing centres for B.S. Boxes where used with slide-grip hangers.*
- *For single* and *continuous mounting.*
- *Philips Sprung Rotor lampholders with earth plungers for lamp end-caps – rapid fixing, automatic positioning.*
- *10 amp. mains terminal block, and earth connection.*
- *Full length back plate with rigidly secured cast alloy ends providing earth continuity for end-entry conduit.*
- *Easily removed plastic inserts for end-conduit entries.*
- *Cable way for through wiring: cable cleats provided.*

They'll be in big demand – order now!



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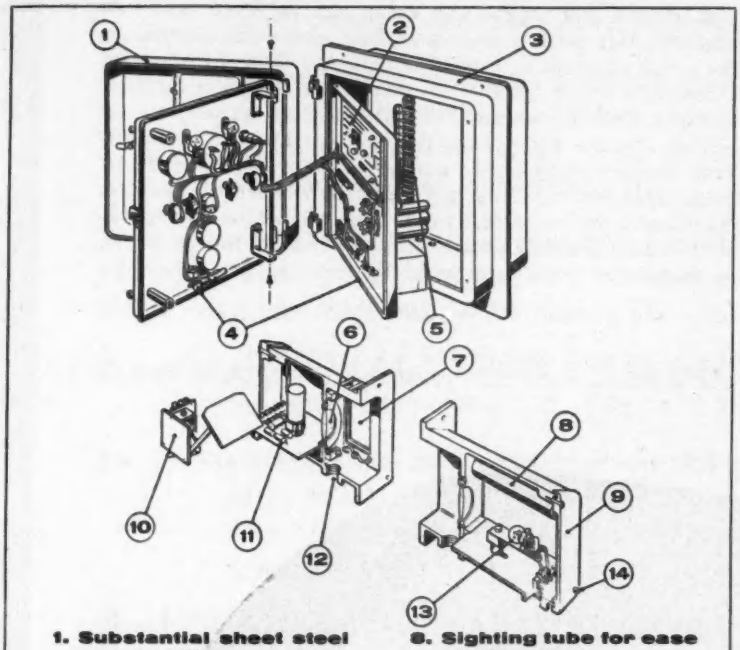
The Lancashire Dynamo Smoke Alarm protects you by warning when the Clean Air Act smoke limit is exceeded.

Priced at well under £100—yet engineered to the highest standards and manufactured and tested to rigorous specifications—the equipment offers a plus—simple conversion to smoke density indication for combustion control and fuel saving.



1. **Substantial sheet steel construction.**
2. **Printed circuit amplifier unit.**
3. **Optional flange mounting accessory.**
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5. **Accessible external connections.**
6. **Rigidly mounted lens assemblies.**
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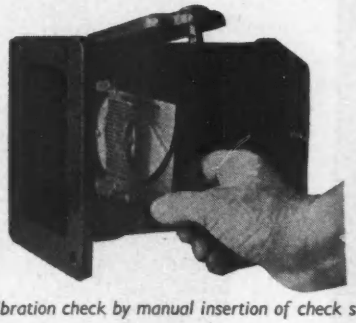
9. **Solid cast iron construction with sealed covers.**
10. **Optional remote standardising accessory.**
11. **Withdrawable printed circuit card carrying photocell.**
12. **Entry for customer's conduit.**
13. **Simple rugged lamp mounting and adjustment.**
14. **Stainless steel fittings.**

Main unit showing locked away controls and calibration meter.



Calibration check by manual insertion of check slide.

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This equipment is the first of its kind to carry the British Standards Institution's "Kite Mark", which indicates independent certification of compliance with BS.2740/56 or, plus the appropriate indicating instrument, with BS.2811/57.

In addition — from one source — all necessary installation accessories including chimney and flue fitments, indicators, recorders, alarm bells, horns, multicore cabling — write for full details.

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Aluminium foil electrical coils, of almost any length and width, are an important new development in the electrical industry. Foil, with a thermo-setting insulating coating on one side, is wound into a reel like a roll of adhesive tape. The coils are then stoved to set the insulation. The result is a structurally stable block with no need for cheeks or formers, and immune to moisture and corrosion. Extreme accuracy—guaranteed to ± 0.002 in.—can be obtained by machining the coils on a lathe, while mild etching eliminates short circuiting. The difference in conductivity between copper wire and aluminium foil is offset by the better space factor of the rectangular section. There are no voids between the turns so heat diffuses evenly from turn to turn and from the middle to the ends, abolishing 'hot spots': the coils are thus tolerant of high temperatures and are easily cooled by fan or water. Low P.D. between adjacent turns makes foil coils inherently safe from internal shorting.

WE OFFER YOU full technical advice and finished coils, or coated foil for your own winding

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NEWS SHEET

Four more types of appliance called up for approvals testing. BEAB offers testing of shavers, toasters, coffee percolators, and washboilers. Applications by 31 Jan. for 1 May approval. Electric blankets to continue kitemarked by BSI. New BS 3456 to be issued to cover all appliance safety testing at Approvals Board request. (1, 27)

Overheated secondary windings caused transformer failures on Glasgow trains, inquiry reveals. Explosions and damaged transformer tanks and conservators said to be due to hot oil vapour. Investigation continues into basic cause of overheating. (12)

First move to common European external tariff by Common Market Six now in force, and with third 10% cut in internal tariffs will make trading harder for British firms. (29)

Proposed merger of Bruce Peebles with Belmos. Talks have been taking place but details not yet finalised. (27)

59% rise in USSR generating capacity from 1955 to 1959 leads West Germany, 34%; USA 33%; UK 29%. Plant installed, 59,142 MW in 1959 compares with 174,139 MW for USA; recorded in European electrical statistics bulletin. (8)

First hydro-electric scheme in Outer Hebrides commissioned. Loch Chliostair station has two 500 kW sets operating on 400 ft head. (27)

Electric trains 18 months ahead of schedule running between Dover and Ramsgate. Extension to London unlikely to be completed ahead of original target of June, 1962. (28)

In New Year Honours List: knighthoods awarded to Dr C. Dannatt (AEI), and A. R. Lewis (Decca). CBE for J. B. Scott (Crompton Parkinson) and J. R. Pheazey (STC), with OBE for W. N. C. Clinch (controller, Eastern Division, CEGB) and S. J. Emerson (senior electrical inspector of factories). (18)

PEOPLE—F. Linley is new deputy chairman, North Western EB . . . L. C. W. Turner joins Thomas Bolton and Sons as director and general manager . . . David Brook becomes sales director, Brook Motors . . . E. Kirkland promoted to deputy chief engineer and G. A. W. Riley to deputy chief accountant, North Western EB . . . P. R. Armitage becomes manager, GEC traction division . . . Dr R. H. Golde appointed head of ERA surges and transformer dept. with M. Waters as deputy head . . . C. W. Villiers joins board of Morphy-Richards (Cray) . . . J. D. Riddle becomes manager, large machine and compression dept., AEI Heavy Plant Division . . . A. G. Wray promoted to deputy chief engineer, Marconi Instruments. (16-20)

NEWS SHEET

New breakthrough in control engineering possible with silicon controlled rectifier, offers fast switching with compact size, robustness and simpler circuits for currents up to 25 amp. Theory and characteristics discussed in first part article. (1, 3)

224 MW pumped storage plant aids generation peaks; Austrian station, in operation two years, provides water storage for seasonal and daily peak loads. Motor also used as generator with hydraulically accelerated pump unit. (14)

Service resumed on Liverpool Street eastern electric suburban lines. Forty-two of 52 three-car units now modified. No date set for restoration of full service. (29)

Electrical warehouse gutted at Nottingham. At least £100,000 damage in Furse Wholesale Ltd. fire, but stock and premises insured. (29)

Maintenance platform 275 ft up a feature of Thames 275 kV crossing towers. River traffic will be stopped during conductor stringing on the 7,700 ft span between anchor towers, with 615 ft suspension towers. (21)

Corrugated seamless aluminium sheaths offer many advantages for power cables, especially in larger oil-filled designs. Sheath configuration permits small bending radius with thin sheath walls. (2, 9)

Domestic electric appliance centre for London opened by AEI-Hotpoint in Oxford Street; aim to serve as shop window for foreign buyers. (29)

Care can avoid troublesome damage to customer's property in contracting, argues district contracting engineer in article recording experience, but more consideration by appliance manufacturers needed. (7)

BUSINESS—Derritron group acquire three more electronic firms. (27) . . . Now fully US controlled, Leeds and Northrup plan expansion. (28) . . . One-for-two scrip issue by Colvern . . . Kenwood Manfg Co. had £1,320,000 bank overdraft at 31 July . . . Bruce Peebles warn that ordinary dividend for 1960 is unlikely . . . Hartley Baird to take over Limit Engrg Co. . . . Dusseks acquire Claud Campbell. (34)

OVERSEAS—Controversy over Columbia River, Canada, finances . . . B.C. raise water levy . . . Reorganisation of supply in Rhodesia recommended by consultants . . . British Guiana completes arrangements for nationalisation of Demerara undertaking . . . In Pakistan, 30 MW station planned for Sukkur. (32, 33)

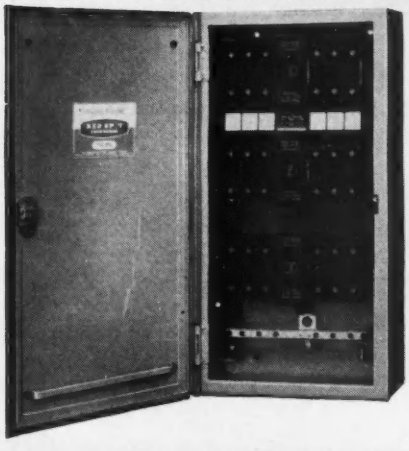
FOR MODERN BUILDINGS

The continual increase in the use of electric power consuming devices in all types of buildings calls for well designed distribution equipment of proved performance. 'ENGLISH ELECTRIC' meet these requirements with their 'Superform' Switchboards and 'Red Spot' Fuseboards.

EASY TO INSTALL • EASY TO MAINTAIN
SAFE TO OPERATE • OF PLEASING APPEARANCE

'SUPERFORM' SWITCHBOARDS

These switchboards have all the 'live' metal insulated, including busbars, interconnections, cable terminations, instrument and meter terminals, switch contacts and terminal blocks. Thus spare switches included on the switchboard can be cabled up safely with the existing circuits in operation.



'RED SPOT' FUSEBOARDS

Designed with concealed hinges and push button door catch having provision for locking by means of a built-in cylinder lock, 'Red Spot' fuseboards have the busbars and incoming cable sockets fully insulated. The fuse contacts and fuse terminals are covered by insulated shrouds. These features provide safety to electrical personnel by enabling spare fuseways to be cabled up with the busbars alive.

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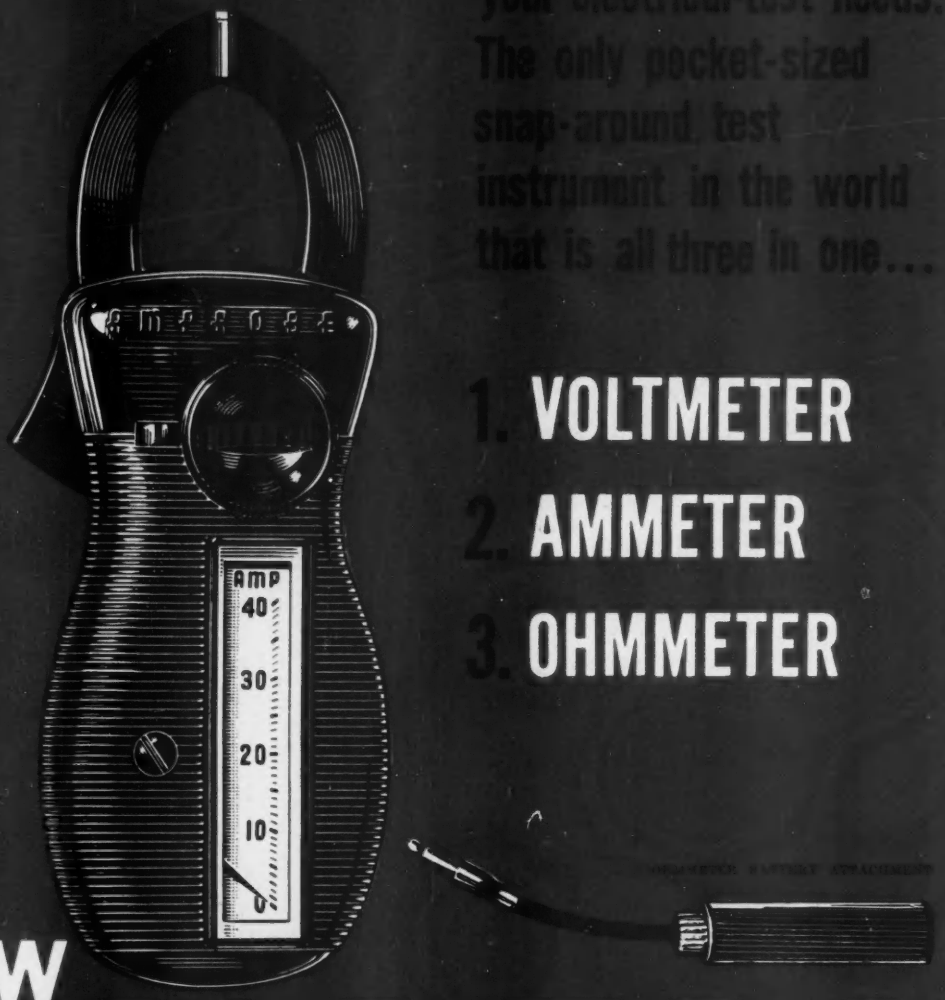

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Otter 'PUP'

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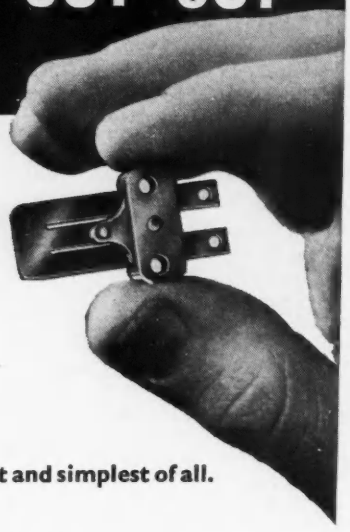

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* **Has only one moving part.**
* **Patented "Otter" snap action.**
* **They PRESS their contacts together to open them with a snap !**
* **The lowest priced reliable thermostat.**

Otter Pups are suitable for the protection of Portable Electric Heaters, Convector Heaters, Hair Dryers, Clothes Dryers and for accurate temperature control, especially where space for the thermostat is limited.

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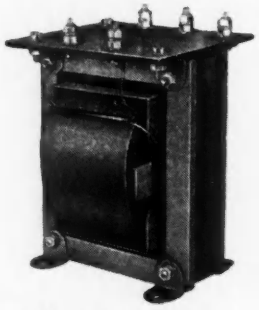

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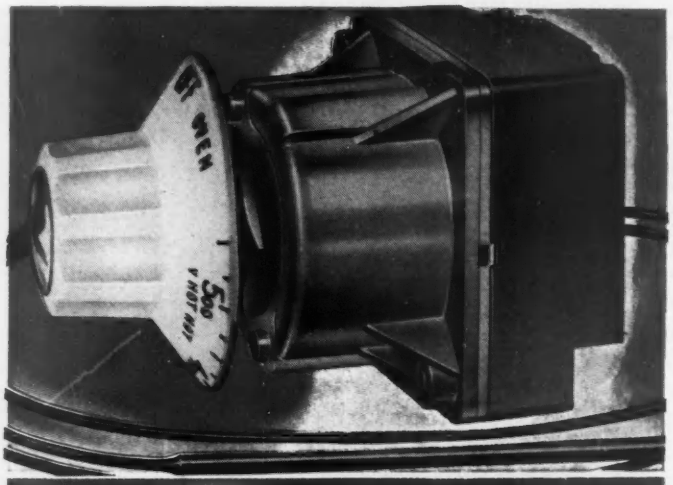
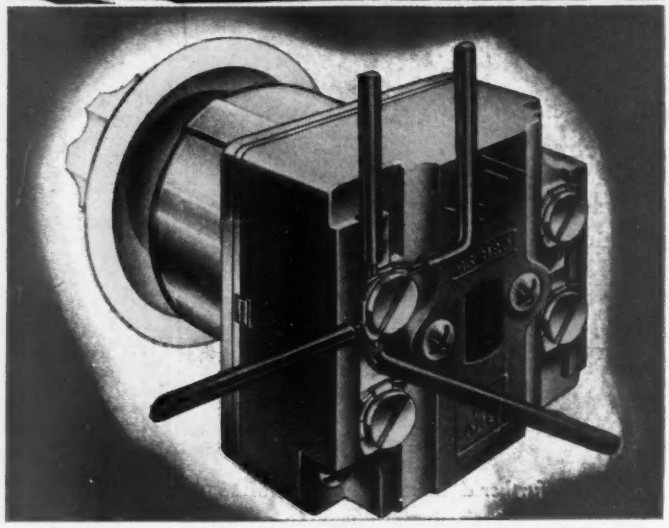
FM 131/2

The new 20TH Series

the latest development of the 'DIAMOND H'





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The 20TH Series incorporates all the features of the 2TH (over 3,000,000 are in use) PLUS these advantages

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- Meets requirements of BS 3180.
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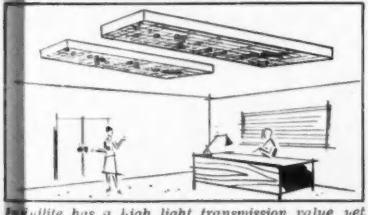
lightweight sections interlock without visible joints

Consider the architectural possibilities of a luminous ceiling material that cuts to any size and shape, that is dimensionally stable, yet so light that it is suspended only by slender wires. This is Infinilite. Its light transmission value is one of the highest of any luminous ceiling material, yet brightness control rings ensure remarkably low surface brightness.

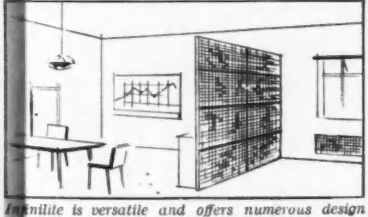
Infinilite comes in standard 24" x 25" interlocking panels that clip together to form ceiling areas of any size.

Investigate Infinilite — luminous ceiling — room divider — decorative material — and in imaginative hands much more besides.

Infinilite weighs so little, it is suspended by slender wires only. No T beams.



Infinilite has a high light transmission value yet surface brightness is exceptionally low.



Infinilite is versatile and offers numerous design and decorative possibilities.

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...you to sell more and more lamps

Make it a prosperous New Year with Osram

Make sure of your stocks NOW of the 100, 60, and 40 watt Osram Extra Light Lamp.

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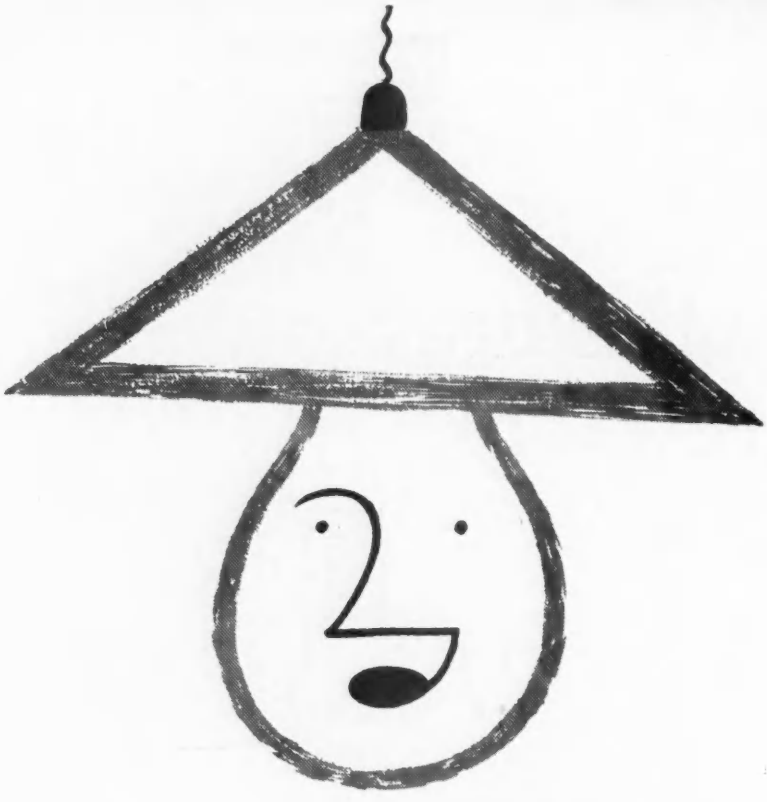

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I'M WASTING YOUR MONEY

I can't compete against sunlight, you know! In fact, I look so dim in daylight that they keep forgetting to switch me off. But I'm still bright enough to see that I'm wasting electricity! Why don't you fit a **SAVELITE**? Why not indeed? The 'Savelite' is a new photo-electric device which warns factory and office workers when to switch off unnecessary lights. Easily and cheaply installed in individual offices and workshops, it cuts electric light bills to the barest minimum, and saves its cost in a very short time.

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SAVELITE

IT REACTS TO LIGHT AS A THERMOSTAT REACTS TO HEAT

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REWIRABLE OR H.R.C.

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M.E.M. H.R.C. cartridge fuse carriers are designed to accommodate H.R.C. cartridge fuse-links made to B.S.88 : 1952, Appendix 'J' Dimensions, Form A—Offset Tags.

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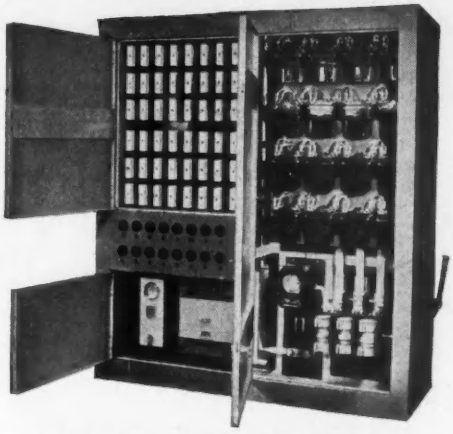

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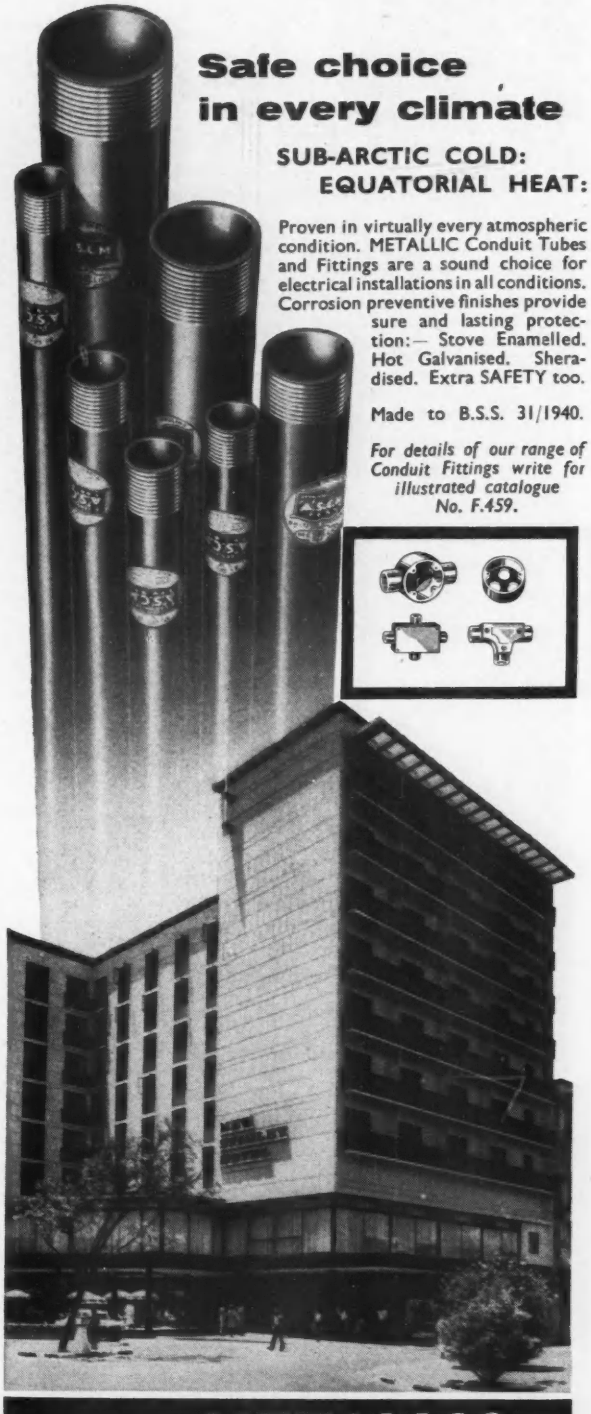

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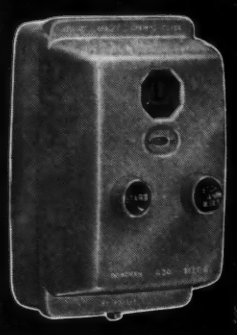

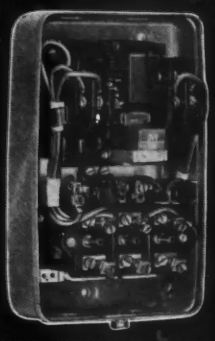

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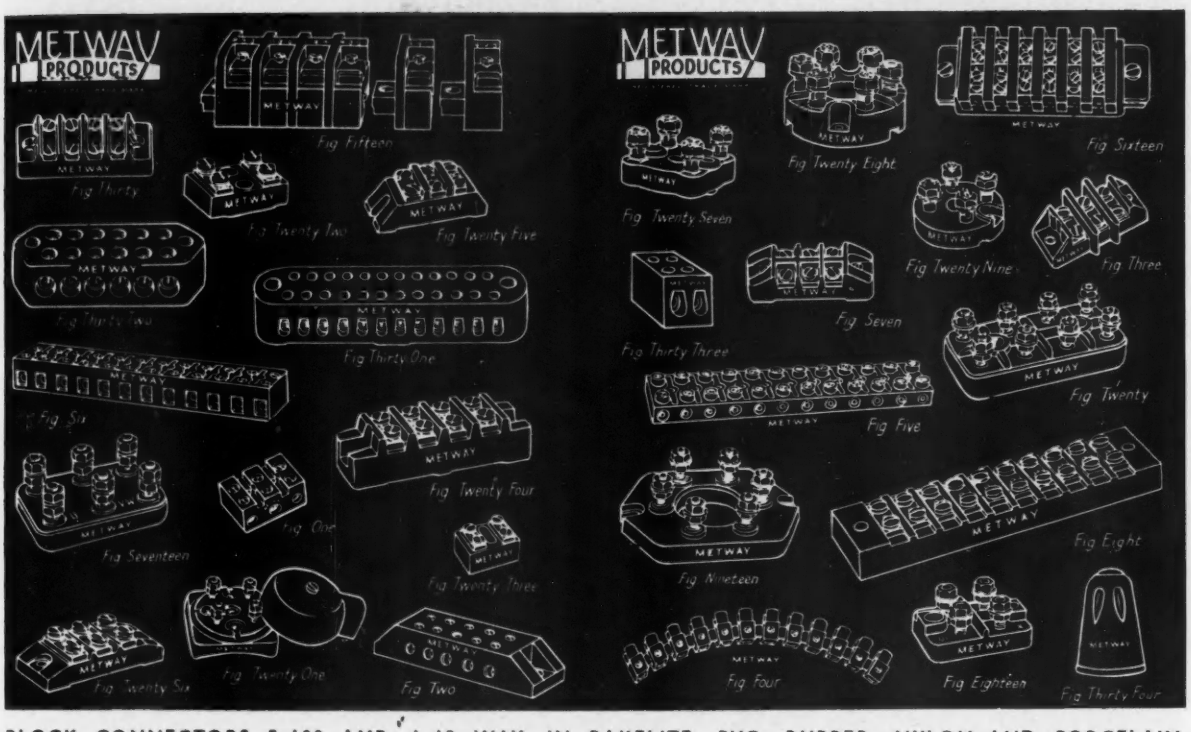

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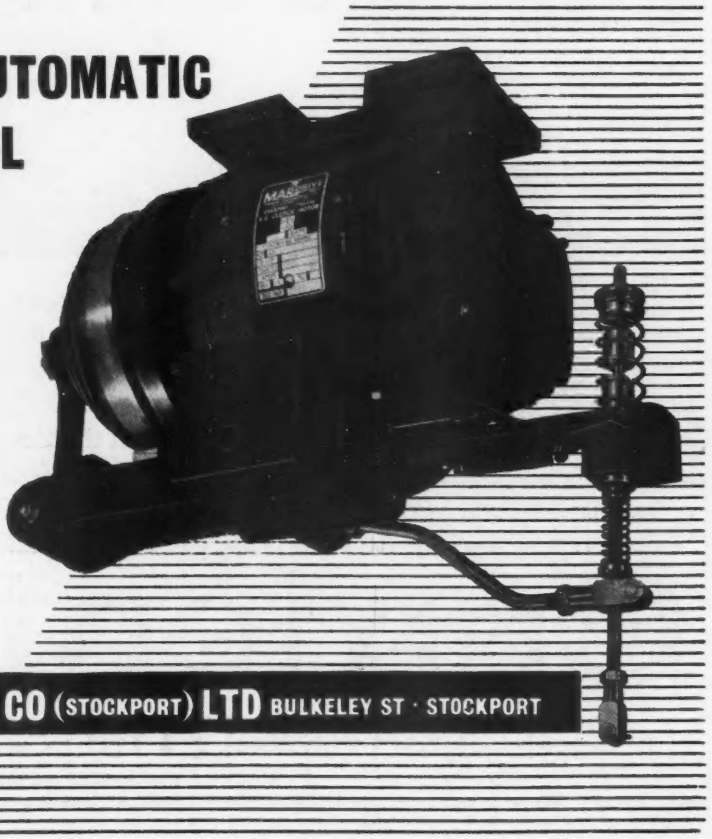

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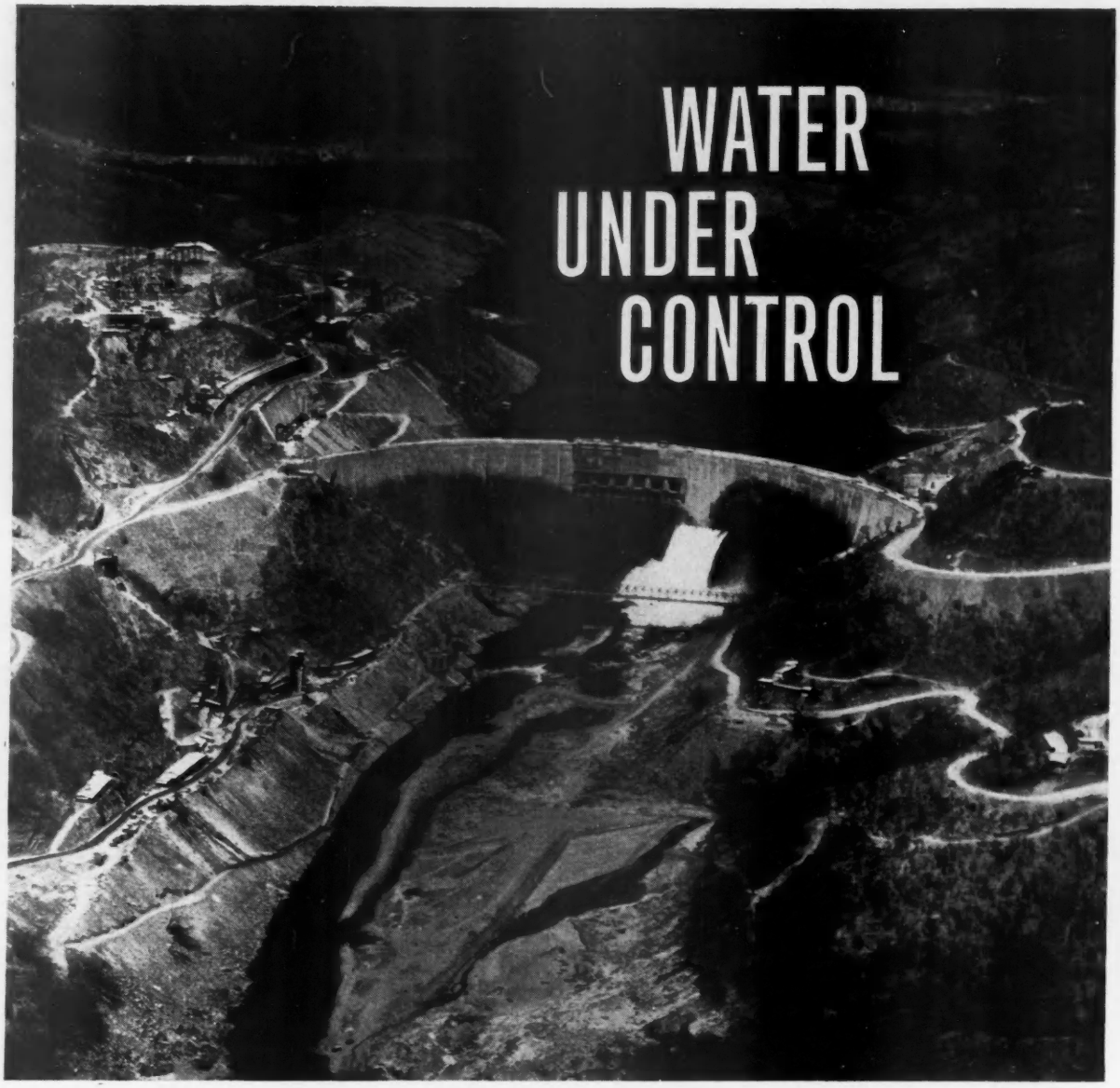

At Kariba the cut-off and blanket treatment below the main dam and the high pressure rock consolidation for the underground power station, extending some 400 feet below impounded water level, are vital elements of the project. These were among the many specialist works entrusted to The Cementation Company on this project.

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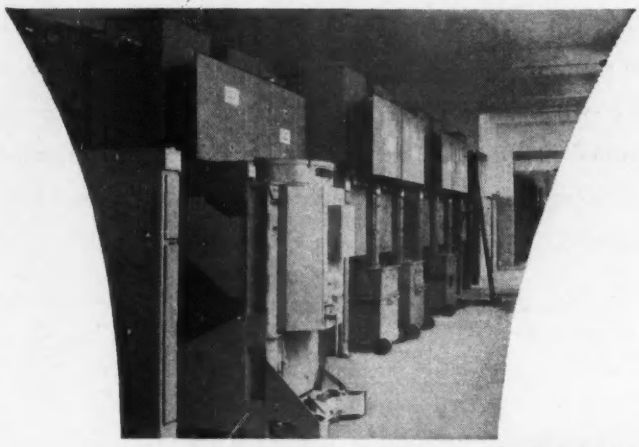
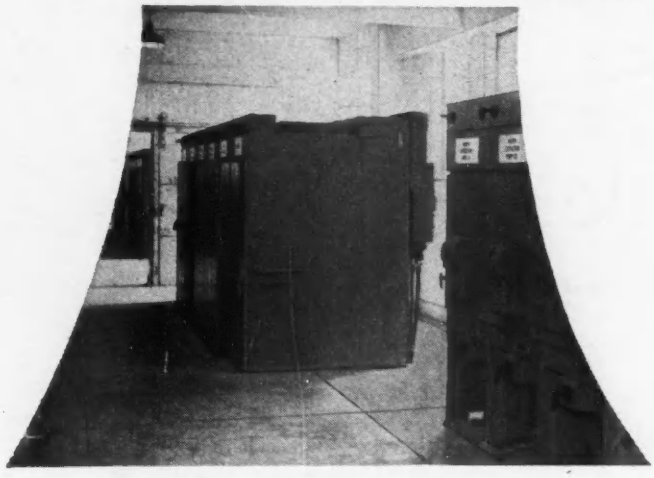


POWER STATION SWITCHGEAR IN SOUTHERN RHODESIA



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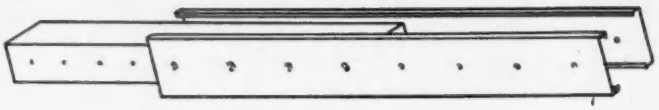
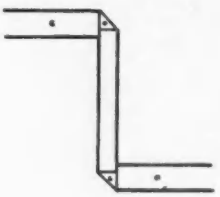
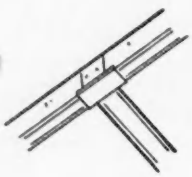


The overlap method of construction ensures fixings up to 18 ft centres



90° riser



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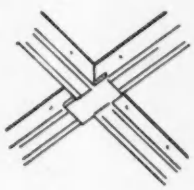
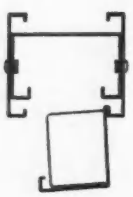
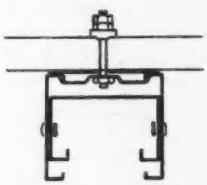


crossover



easy maintenance

easy assembly



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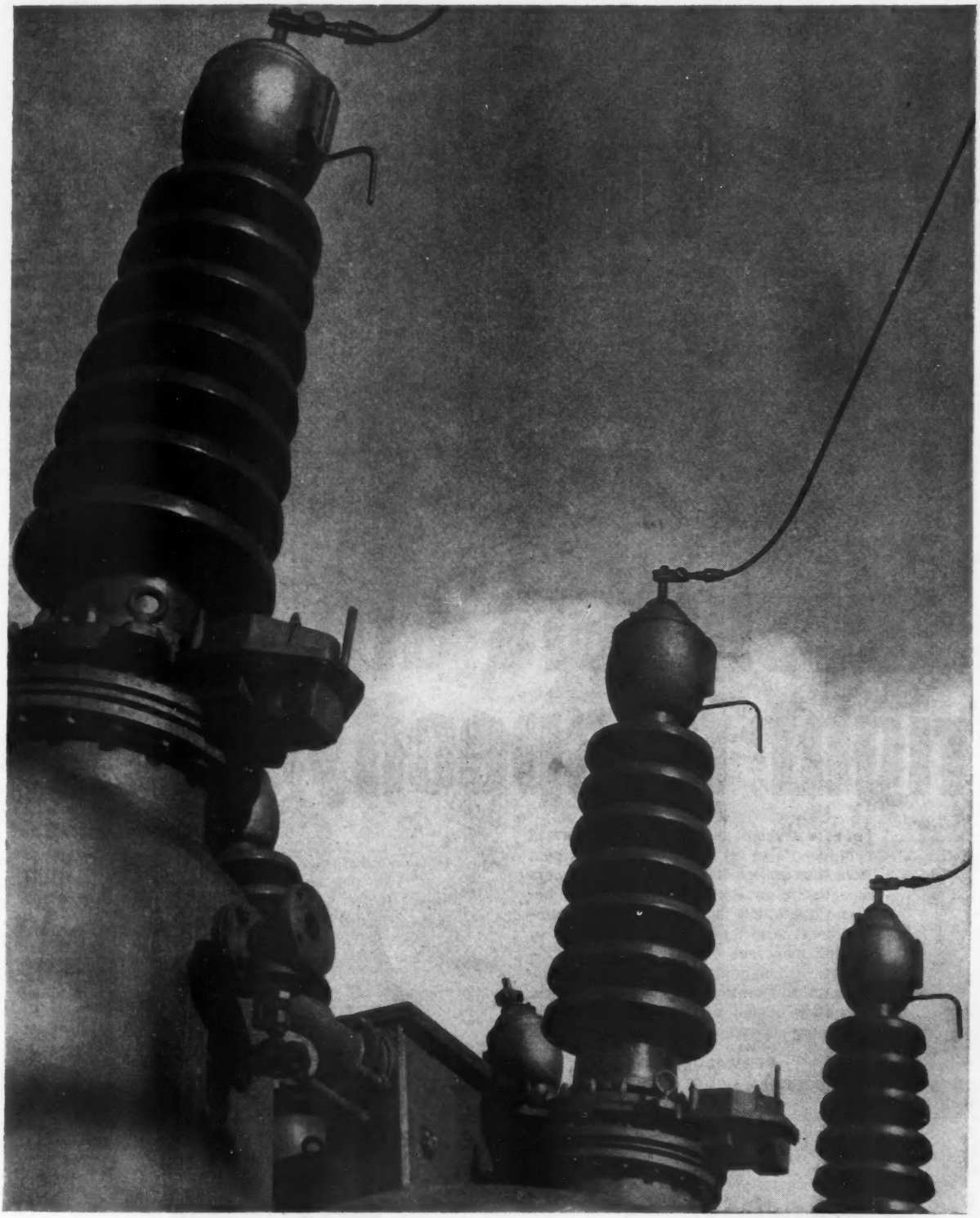

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419

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THURSDAY 5 JANUARY, 1961
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ELECTRICAL TIMES

SARDINIA HOUSE, SARDINIA STREET, LONDON, W.C.2
Telegrams: Equivolt . Estrand Telephone: HOLborn 6016

The Silicon Controlled Rectifier—Part 1 3
by J. H. R. Manners, B.SC.

Care When Contracting 7
by F. G. Stevens, A.M.I.E.E.

European Energy Statistics 8

Corrugated Seamless Aluminium Sheaths 9
by D. McAllister

Glasgow Train Inquiry 12

Pumped Storage in Austria 14

The New Year Honours List 18

Supergrid Crosses the River Thames 21

Progress in Manufacture, 1960, No. 1—C. A. Parsons ... 23

Dans ce numéro

Redresseur Reglé au Silicium 3

En termes d'électricité, ce redresseur se présente, en principe, sous la forme de deux transistors p-n-p et n-p-n, possédant deux éléments n-p communs. Les courbes caractéristiques données sont celles d'une unité pesant 85 grammes et capable de contrôler 26 ampères pour un courant de régulation de 10 milliampères. Les courbes principales ressemblent à celles d'un thyratron, ce qui avec les avantages des transistors permet de nombreuses applications dans le domaine de la régulation.

Gaines en Aluminium Cannelé sans Soudure 9

On utilise maintenant des gaines en aluminium cannelé sans soudure (C.S.A.) pour les gros câbles de puissance. Ce type de gaine offre de bonnes caractéristiques de pliage pour une épaisseur réduite, et apporte des changements substantiels d'ordre économique par comparaison avec les gaines de plomb. Dans le type de câble à huile, aucun renforcement mécanique de la gaine n'est rendu nécessaire par la pression interne. Ces câbles ont trouvé des applications dans les feeders suivant les voies, dans l'électrification des réseaux ferrés.

Centrale Hydroélectrique à Réserve Pompée en Autriche 14

Une centrale de 224 MW à réserve pompée fonctionne à Lünersee, en Autriche, depuis deux ans. Cette centrale est équipée de six turbines de 54 000 CV conçues pour une hauteur de chûte moyenne de 876 m. La pompe, placée verticalement au dessous de l'ensemble turbine moteur/génerateur est entraînée par l'intermédiaire d'un accouplement hydraulique. Les pompes retournent l'eau du lac de retenue de Lünersee au cours des périodes creuses journalières et saisonières. L'eau restante de la centrale alimente une seconde centrale hydroélectrique, située à Rodund, par l'intermédiaire d'une chûte de 347 m.

In dieser Nummer

Die Silizium Vierplatte Triode, I 3

Die Theorie der silizium gesteuertengleichrichtung besteht—elektrisch gesprochen—in der Verwendung zweier p-n-p und n-p-n Transistoren mit je zwei gemeinsamen n-p-Elementen. Die Beschreibung gibt Kennlinien einer solchen Triode wieder, die 85 g wiegt und eine Steuerleistung von 26 A besitzt bei einer Steuerstromaufnahme von 10 mA. Die Haupteigenschaften entsprechen ungefähr denen eines Stromtors und sichern, gepaart mit den Vorteilen der Aufbau in der festen Phase, eine vielseitige Anwendbarkeit in der Steurungstechnik.

Nahtlose Aluminium-Wellbewehrung 9

Nahtlose Aluminium-Wellbewehrungen ("CSA"-Bewehrungen) werden heute vielfach für Hochspannungskabel grösseren Querschnitts verwendet. Diese Bewehrungsart bietet ausgezeichnete Biegefähigkeit bei reduzierter Wandstärke und beträchliche wirtschaftliche Vorteile gegenüber einer Bleibewehrung. Bei einer Ausführungform mit Oelfüllung erübrigt sich jede Armierung gegen Innendruck. Solche Kabel finden z.B. in der Bahnelektrifizierung Verwendung u. zw. als Zufuhrleitungen zu den Stromschienen.

Pumpspeicher-Wasserkraftwerk in Oesterreich ... 14

Ein Pumpspeicher-Wasserkraftwerk mit einer Nennleistung von 224 MW steht seit fast zwei Jahren am Lünersee in Oesterreich in Betrieb. Das Werk verfügt über sechs für eine mittlere Stauhöhe von 876 m ausgelegte Turbinen mit einer Nennleistung von je 54,400 PS. Der Antrieb des Pumpenwerks, das vertikal unter der Motor/Turbogenerator-Anlage steht, erfolgt durch hydraulische Kupplung. In Zeiten geringerer Belastung fördern die Pumpen in den Stausee. Unterwasser vom Pumpspeicher-Wasserkraftwerk treibt ein weiteres in Rodund gelogenes Wasserkraftwerk mit einer Druckhöhe von 347 m an.

FEATURES

Around the Trade *by Peregrin* 13
Personalities in the Industry 16
Problems and Practice 22
New Products and Appliances 24
News of the Week 27
Overseas News 32
Company Activities 34
Commercial Information 35

News Sheet 17
Classified Advertisements 43
Index to Advertisers 52

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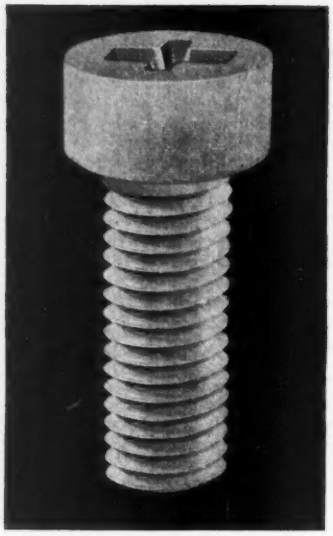

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laboratory
and hospital
equipment
not to keep telling them
about GKN
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and dielectric
strengths are high;
and they can stand
sterilising
again and again;
and their
tensile strength
is 3500 lbs./sq. in
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these chemically inert,
corrosion resistant,
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ELECTRICAL TIMES

ESTABLISHED 1891

THURSDAY, 5 JANUARY, 1961

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K. C. POUNDS, B.Sc.(Eng.), A.C.G.I., A.M.I.E.E.

News Editor:
T. W. WRIGHT

Comment

STANDARD OF APPROVAL

A few weeks ago we foreshadowed the intention of British Standards Institution to produce a single standard covering the "safety" requirements for domestic electrical appliances. Existence of such a standard will make explicit the testing and approval criteria of the British Electrical Approvals Board for Domestic Appliances. Now BSI have publicly announced the manner they are going to set about this project. A single BS number, the easily remembered 3456, has been allocated to the new standard, which initially will appear in a large number of parts covering the specific requirements of particular types of appliance. As a start, two existing standards are soon to be re-issued changed to the new number, but otherwise unaltered. This move permits some evaluation of the width of interpretation BEAB will be placing on its policy of limiting its testing to safety features. The standards to be re-issued cover vacuum cleaners and fires, respectively, and in neither case is there anything in the specification that in any way affects "quality" in the broader sense other than when it is intimately involved with sustained safety of the appliance. On the other hand, the detailed nature of the test clauses, including cross-check requirements of nominal loading against measured power input at specified pneumatic load (in the case of the vacuum cleaner) and life and short-circuit tests on switches, go beyond what would be expected on a narrow interpretation of a "safety only" criterion. It is highly improbable that any shoddy design would pass scrutiny for compliance with the standard. That is the story that has to be got over to the general public when the BEAB mark comes into use in the spring.

NEW TOOL FOR CONTROL

Over the past two years, semiconductor devices have not only increased in current handling capacity to bring them within the power field, but the type of device available has extended as well. The transistor is now to be had with ratings well beyond those required in radio engineering, but it is that new device, the silicon controlled rectifier, that offers power engineers a whole new field of application. Broadly it may be considered as a semiconductor equivalent of the thyratron with the added advantages of higher efficiency, greater robustness, simpler circuitry and fast switching times. The ability to switch currents up to 25 amp directly from an originating signal of a few milliamps with only a few micro-seconds delay has such obvious advantage in control engineering that this new device is receiving close attention in all industrial countries. The theory and characteristics of

ELECTRICAL GROUPS—A revised and enlarged edition of our "Electrical Groups and Associated Companies" publication faces page 34 of this issue.

this device are dealt with in an article commencing in this issue, which will later sketch some of the broad fields of application. The physics of this device are reasonably well known and its manufacture will be facilitated as supplies in quantity of pure semiconductors, promised for this year, become available from chemical manufacturers. As the controlled rectifier moves into the field of specific commercial application it may well become to control engineering what the transistor has been to the field of radio.

CORRUGATED SHEATHING

Aluminium as a cable sheathing material has a number of attractions, but at least one serious disadvantage: its stiffness relative to what engineers have become used to in handling lead-alloy sheathed cables. In confined spaces, the resultant difficulty in manipulating aluminium-sheathed cables has been a factor of some importance. A thinner sheath might be satisfactory from most mechanical aspects, but it has the fatal characteristic of kinking on bending if beneath a critical thickness. The solution that has been developed, and is now becoming more common in the British cable industry, is the corrugated sheath. The apparent complexity of form is of less importance, in that little success has been achieved with the direct extrusion of aluminium sheathing over cable cores; processes such as welding or swaging down have to be used even with plain sheaths. One of the two main methods of corrugating is described in an article later in this issue. It involves forming the corrugations in a swaging-down die, and accepting some limit to length of continuous sheath, in contrast to the alternative, which uses argon arc welding of a continuous strip of aluminium folded round the cable core. The result of corrugating is a notable improvement in flexibility, with the bending radii possible with lead alloy sheaths easily equalled and the pressure-retaining qualities of the aluminium sheaths retained. This fits in well with the growing use of oil-filled cables in this country. Modern methods of sheath protection using plastics as the main guard against corrosive influences in the soil makes it possible to cope readily with the serving problem.

NEW YEAR CHANGES

Something more than a switch back to page 1 and a new volume number marks this issue of the ELECTRICAL TIMES. Readers will find some of their favourite features changed in style or position. This is not mere journalistic gimmick-hunting or early spring fever on the part of the editor. As times change, so the needs of the industry alter, and it is right that these should be reflected in the pages of its technical newspaper. The widening range of important industrial equipment being introduced by electrical firms and the continued overlap between designs appropriate to the heavy power user and the retailer, respectively, have led us to replace our twin-headed review of new products, Equipment for Industry and For the Electrical Trade, by a single feature, New Products and Appliances. The change will make possible a more flexible approach to a most important service to readers. Although in this first week it is the change in presentation that is most apparent, we hope that in coming issues the wider coverage being secured for this feature will show through. Another much-valued section of the paper, Overseas News, has been moved to the main news section of the issue, a change implying no marking down of importance of this exclusive weekly summary based on an extensive overseas correspondence. Quite other considerations have prompted the change, as also other alterations in presentation which the perceptive reader may notice. The coming weeks will reveal still more advances to improve the utility and handiness of the ELECTRICAL TIMES.

GENERATION FOR SPACE

Interest in the exploration of space is proving highly effective in forcing the pace of development of unconventional means of electricity generation. This is well illustrated in a recent issue of *Electrical Engineering*, the journal of the American IEE, largely given over to the question of electrical power in space probes. The underlying philosophy seems to be that the equipment in such devices ought to get its operating energy from the space being traversed. Direct conversion from heat—available in the form of solar radiation since there is no cloud obscuration to worry about—to electricity is the order of the day, and thermo-electricity and thermionic generation are under close study despite their low efficiencies compared with more familiar generation techniques. Associated with this work is interest in practical applications of the superconducting state, pursued through the fast-growing technique of cryogenics, which proceeds downwards in temperature from the −196°C boiling point of liquid nitrogen to the near-absolute zero of −273°C. Since rockets carry large quantities of liquid hydrogen and oxygen as propellants, cryogenics offer the chance of decreased power demand in some highly complex control equipment. All these techniques have wide potential applications in everyday engineering, as well as in the still-exciting realm of space exploration. Any important break-through in design or knowledge must be watched for closely, with an eye on early exploitation on Earth.

Meteor

This week's quick summary of electrical news faces advertisement page 16

Fig. 1. Diagrammatic form of controlled rectifier

The Silicon Controlled Rectifier

PART 1. THEORY OF OPERATION AND CHARACTERISTICS

by J. H. R. Manners, B.Sc.*

ONE of the most significant advances in recent years in the field of power control and allied applications has been the introduction of the silicon controlled rectifier. This is a semiconductor analogy of the gasfilled triode or thyratron, but without some of the drawbacks of the latter, and with certain decided advantages. Listed among the advantages are; very low voltage drop in the conducting state, associated with an extremely low forward resistance, small size and weight for a given power handling capacity, robustness, fast switching times and absence of heater and warm-up time.

The voltage drop across a silicon controlled rectifier is about 1 V when maximum continuous current is flowing, rising to a little under 2 V at peak current. A typical example of forward resistance when the device is in the conducting state is 0·02 ohms, this figure referring in particular to the CS31 series of "Trinistor"† silicon controlled rectifiers.

A Trinistor in the CS31 range occupies about 1 cu in. and weighs about 3 oz, whilst being capable of carrying a mean forward current of 26 amp. Comparable gas or vapour filled thyratrons are considerably more bulky.

Due in part to their small size and weight, and to the fact that they are more or less solid lumps of material, silicon controlled rectifiers are relatively immune to vibration and shock, and may be employed, therefore, in circumstances where thyratrons and the like would be unusable.

The use of thyratrons is also limited by their slow ionisation and de-ionisation times, the analogous switch-on and switch-off times of the silicon controlled rectifier being about an order of magnitude lower. The initial warm-up is eliminated, also, since there is no heater.

† "Trinistor" is a Westinghouse trade mark.

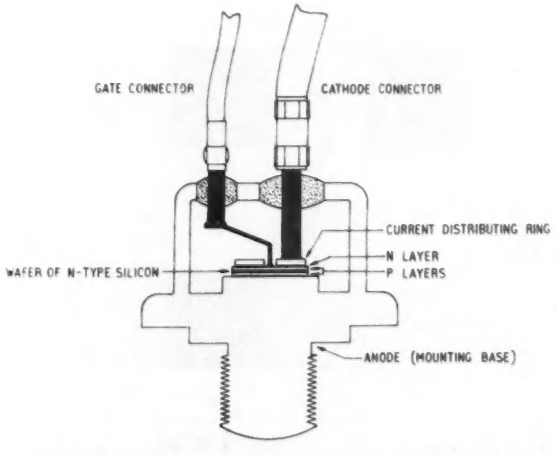

Fig. 2. Physical construction of one form of controlled rectifier

Whilst the thyratron has been specifically mentioned, since it is analogous to the controlled rectifier, the latter can also replace with advantage devices such as ignitrons, power transistors, relays, magnetic amplifiers, and so on, where circumstances are appropriate.

Fig. 3. Symbol of SCR

Typical uses of silicon-controlled rectifiers include control of a.c. power, control of d.c. power, a.c. and d.c. switching, controllable rectification, d.c. to a.c. inversion, d.c. to a.c. conversion, frequency changing, etc., which embrace a very wide field of actual applications, some of which will be described later.

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Basic Action of Controlled Rectifier

In simple terms, the silicon controlled rectifier is a silicon rectifier in which the possibility of conduction in the forward direction is determined by a third electrode, usually known as the "gate." If a voltage is applied between the anode and cathode so that the anode is positive with respect to the cathode, then conduction will not occur until current is fed into the gate electrode. Once conduction has been initiated it cannot be stopped by means of the gate, but only by bringing the anode-cathode current below a certain critical value, known as the "sus-

* Mr Manners is at the Electrical Research Laboratories, Rectifier Division of Westinghouse Brake and Signal Co. Ltd.

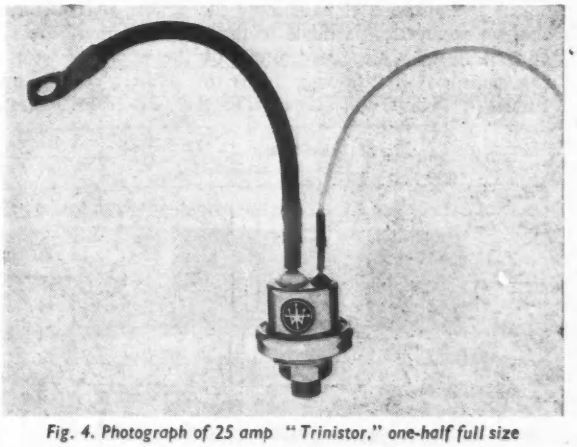


Fig. 4. Photograph of 25 amp "Trinistor," one-half full size

taining current," by means external to the device. In this respect the silicon controlled rectifier is similar to the thyratron.

Conduction can also be initiated in the absence of a gate signal by increasing the anode-cathode voltage to a sufficiently high value, but this method of switching on is not generally recommended and is of doubtful practical use.

The silicon controlled rectifier will not conduct in the reverse direction, and exhibits a reverse characteristic similar to that of a silicon diode of comparable size.

Construction

Although the controlled rectifier may be considered as a rectifier with an added control electrode, it is in fact a more complex structure. Whereas the operating element of a rectifier contains a wafer of semiconductor material having two regions or layers, one p-type and one n-type, the controlled rectifier has four layers, alternately p and n, the gate connection usually being made to the inner p-layer. The structure may be represented diagrammatically as in Fig. 1, while Fig. 3 shows the circuit symbol used for the device. The direction of the arrow corresponds to that in the normal rectifier symbol, and the gate is indicated by the additional connection.

The physical construction of one type of silicon controlled rectifier is shown in Fig. 2. The operating element consists of a wafer of n-type silicon with p-type layers formed on each side and a further n layer formed on top of one of the p layers. The element is attached to the mounting base at the anode end, the cathode and gate connections being brought out through hermetic seals in the casing. In use, the device is bolted to a suitable heat sink for cooling, the heat sink design generally following that used for silicon diodes, since the problems are similar.

Principle of Operation

The action of a silicon controlled rectifier is probably most easily understood by theoretically considering it as consisting of two parts, a pnp transistor and an npn transistor with a common collector junction. This is illustrated in Fig. 5; e, b and c denote the emitter, base and collector in each case. When the device has a forward voltage applied to it, that is to say, when the right-hand side in Fig. 5 is positive, then the centre junction is reverse biased, as is the collector junction in a transistor, whilst the other two are forward biased. This is equivalent to two transistors cross-connected as shown in Fig. 6. The common-base current gains of the two transistors are α_1 and α_2, respectively.

For the purpose of explaining the action, it is assumed that no connection is made to the gate, and therefore the current flowing into the emitter of the pnp transistor is the same as that flowing from the emitter of the npn transistor. Therefore, considering the pnp transistor, the collector current I_1, is given by the usual relationship

$$I_1 = I_{1cbo} + \alpha_1 I \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad 1$$

where I_{1cbo} is the collector leakage current.

Similarly, for the npn transistor, the collector current I_2 is given by

$$I_2 = I_{2cbo} + \alpha_2 I \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad 2$$

where I_{2cbo} is the leakage current.

Clearly, from Fig. 6, the total current, I, is equal to the sum of I_1 and I_2, that is,

$$I = I_1 + I_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad 3$$

Thence substituting in equation 3 for I_1 and I_2 from equations 1 and 2,

$$I = (I_{1cbo} + \alpha_1 I) + (I_{2cbo} + \alpha_2 I)$$

i.e. $$I = \frac{I_{1cbo} + I_{2cbo}}{1 - (\alpha_1 + \alpha_2)}$$

or $$I = \frac{I_{cbo}}{1 - (\alpha_1 + \alpha_2)} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad 4$$

where I_{cbo} is the total leakage current.

Now, it will be seen from equation 4, that if $(\alpha_1 + \alpha_2)$ approaches unity, then I tends to infinity, or in other words, the impedance of the device falls towards zero. Thus if it is possible to control $(\alpha_1 + \alpha_2)$ so that it may be made to change from some low value to a value approaching unity, then the device may be made to change from a high impedance or blocking state to a low impedance or conducting state. In practice, the sum of the two alphas is very much less than one when normal leakage current is flowing, so that the controlled rectifier rests in a stable blocking condition.

The current gains may be made to increase sufficiently for the low impedance state to be reached by two possible methods, although only the second to be described is recommended.

The first method relies upon the fact that as collector-to-emitter voltage in a transistor is raised, the current gain increases slowly at first until a voltage is reached where the energy of carriers arriving at the collector junction is sufficient to dislodge additional carriers, causing an avalanche breakdown. This effect is obtained at the centre junction of a silicon controlled rectifier, resulting in a rapid increase of the two alphas and a very fast transition to the conducting state.

The second method depends upon the increase of alpha with emitter current. With very low values of emitter current the current gain is quite small but rises fairly

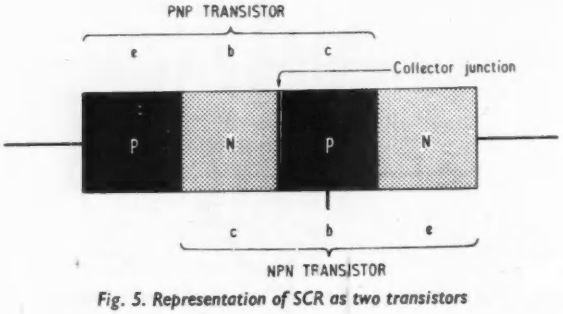


Fig. 5. Representation of SCR as two transistors

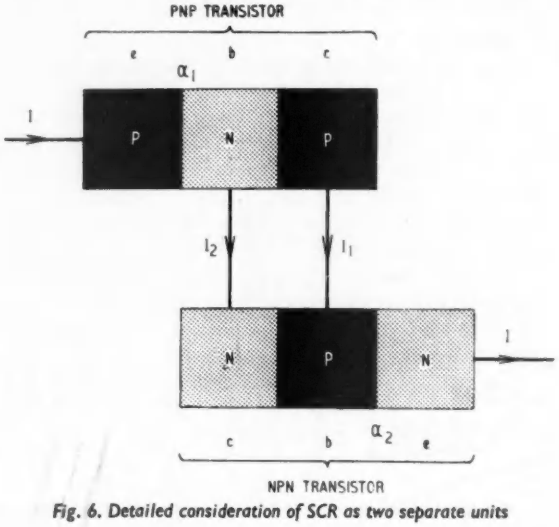


Fig. 6. Detailed consideration of SCR as two separate units

rapidly as the emitter current is increased. In a transistor the emitter current may be increased by injecting current carriers into the base, and in the case of the controlled rectifier the p-region corresponding to the base of the npn transistor in Fig. 6 is generally used in devices made in this country at present, although there is no theoretical reason why either of the two inner regions—or both—should not be used. Injection of carriers into either "base" increases the current flowing through the device and so causes both alphas to increase, and the action may be easily carried to the point where the sum of the alphas approaches unity. The base, or gate, current required to reach this point is quite small, of the order of 10 milliamp for a CS31 Trinistor capable of controlling about 25 amp. A power transistor, however, would probably pass little more than 1 or 2 amp for such a value of base current. In the circuits to be described later, this feature is emphasised by the fact that all the control circuitry used with the devices uses low power transistors and associated components, although the power handled by the controlled rectifiers may be many kilowatts.

From the foregoing paragraphs it will be seen that the separate current gains need not be very high, since it is only the sum which has to reach unity. Therefore, the two base regions need not be as thin as those in power transistors, where high current gain depends upon a very thin base. This means that silicon controlled rectifiers tend to be inherently higher voltage devices than silicon transistors, and this is reflected in published data, where the controlled rectifier ratings often extend to 400 V or more.

Voltage and Current Relationships

Application of an increasing forward voltage to a controlled rectifier when the gate is open-circuited results initially in only leakage current flowing. As the applied voltage increases, this current, in an ideal unit, remains substantially constant, in a similar manner to the reverse current of an ideal silicon rectifier. As the voltage increases further, the current ultimately begins to rise, until finally at a critical voltage, V_{bo}, termed the breakover voltage, it reaches a critical value, I_{bo}, called the breakover current. The current then increases very rapidly and the device breaks over into the low resistance conducting condition. Once the breakover condition has been reached the blocking state can only be regained by reducing the current through the device below a certain critical value, I_s, known as the sustaining current.

If the gate electrode is connected to an external circuit in such a way that current flows into the gate, then the anode voltage at which breakover occurs is reduced, and if the gate current is sufficient the controlled rectifier will not block at all in the forward direction, the characteristic becoming similar to that of a normal silicon diode. As previously mentioned, the reverse characteristic is similar to that of a silicon diode and does not exhibit a breakdown characteristic. However, the reverse current will be increased if current is flowing into the gate (assuming the p-layer is used for this electrode) since the device acts like a transistor with the gate as its base when a reverse voltage is applied between anode and cathode. It is thus possible for appreciable reverse current to flow whilst the full, or nearly the full, reverse voltage appears across the device, so that the device dissipation can be considerable. To prevent this, the permissible gate forward voltage is very low when reverse voltage is applied between anode and cathode, a typical value being 0·25 V, whilst the rating may be 10 V when forward voltage is applied. Fig. 7 shows the anode-cathode voltage and current relationship.

In all practical applications the controlled rectifier is used either in its fully blocking state, i_{g0} in Fig. 7, or in the fully conducting state, represented by the curve i_{g3} in Fig. 7. Intermediate values of gate current and breakover voltage are not used in power control applications, the device being used purely as a switch. In principle, power control in all applications is achieved by controlling the duration of the conducting and non-conducting periods. This will be discussed in more detail under the various applications to be described in the second part of the article.

Switching Times

As has been previously mentioned, switching times of silicon controlled rectifiers are very short compared with other devices performing a similar function. The turn-on time of the type of controlled rectifier being discussed is of the order of 2 μs, with turn-off time being roughly ten times this figure, although in a practical circuit, since turn-off cannot occur until the current has fallen below the sustaining current value, the actual time taken for the blocking state to be regained after switch-off has been initiated will depend upon the nature of the external circuit. For example, in an a.c. control circuit, conduction cannot cease until the end of the half-cycle of current in which the switch-off has been initiated.

A typical turn-on characteristic is shown in Fig. 8. The turn-on time is made up of two parts, a delay time and a rise time, which are of roughly equal duration but depend to some extent upon circuit conditions. The delay time is commonly defined as the time taken for the voltage between anode and cathode to fall to 90% of its initial value, and the rise time as the time taken for this voltage to fall from 90% to 10% of it initial value. These times are sometimes defined using the current rise through the device as reference, hence the apparently contradictory

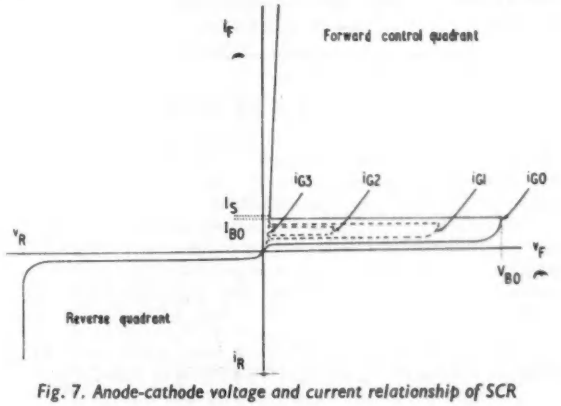


Fig. 7. Anode-cathode voltage and current relationship of SCR

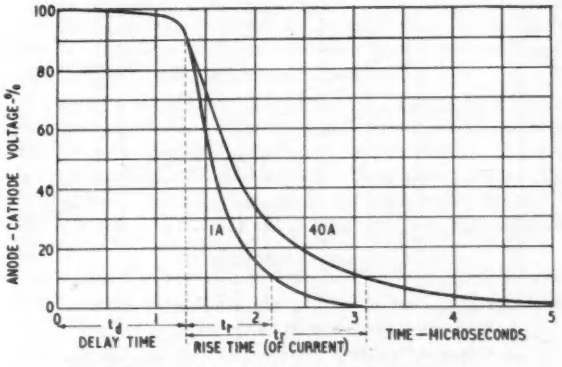
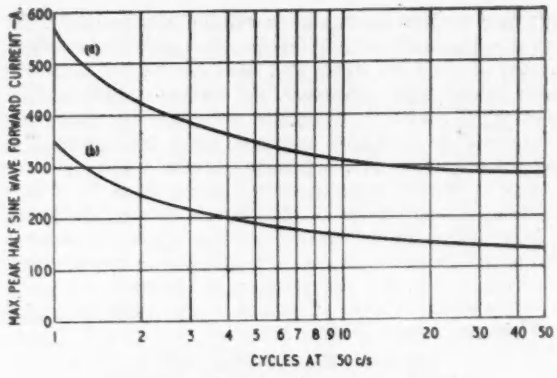


Fig. 8. Turn-on characteristics of voltage against time



(a) Voltage reduced below 10 per cent during surge and not re-applied.
(b) Voltage maintained during surge.

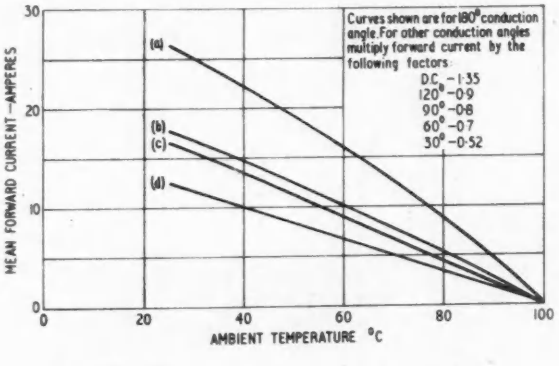
Fig. 9. Ability to withstand high short time overloads

term "rise time" applied to a fall of voltage. Turn-on time varies as an inverse function of the anode-cathode voltage and of the gate current and as a direct function of the load current in the ON condition. Turn-off time varies as a direct function of the load current and of the junction temperature, and as an inverse function of reverse anode-cathode voltage.

In addition to the turn-off time, there is a further period, called the recovery time, during which forward voltage may not be reapplied at a rate exceeding a specified figure, if the blocking condition is to be regained. This figure may be specified in manufacturers' data as a fixed figure, or set of figures, or as a curve of forward voltage against time, or in the form of a formula from which forward voltage or recovery time may be calculated.

Overload Capabilities and Protection

Silicon controlled rectifiers, in common with other semiconductor devices, have working elements which are very small for a given power handling capacity relative to most other comparable devices, such as selenium rectifiers, for example. The thermal capacity is low, in consequence the working elements heat up rapidly in operation and will not withstand sustained overloads. Very high short time overloads may be applied without damage, and this is illustrated in Fig. 9. The normal maximum peak running current for the controlled rectifier concerned is 80 amp, corresponding to a mean half-wave rectified current of 26 amp.



TRINISTOR type CS31 mounted on (a) Westinghouse standard 7" Finnode, (b) Westinghouse standard 4" Finnode, (c) 6" square of 10g. aluminium, (d) 4" square of 10g. aluminium.

Fig. 10. Effect of different cooling arrangements on forward current

To avoid damage in the event of an overload, protective devices must be used and must be fast acting. In practice, ordinary wire and h.r.c. fuses are inadequate, but high-speed h.r.c. fuses will usually provide protection against severe overloads, in conjunction with means to limit the initial overload current to the figure indicated by published data. This is usually accomplished by inserting sufficient impedance in series with the controlled rectifier, or in the supply to it, to ensure that a short-circuit on the load side does not result in a current exceeding the permitted figure. Protection against overloads up to two or three times the running current may be obtained by sensing circuits which feed appropriate signals into the control circuits associated with the controlled rectifiers. Examples are given later in discussing applications.

In addition to providing protection against the type of overload discussed in the preceding paragraphs, it is advisable to take precautions against transient overloads, both voltage and current. Current transients will often be satisfactorily dealt with by the series impedance used for short-circuit protection, but it may be necessary to take additional steps to eliminate or reduce voltage transients appearing on the supply lines or generated in the equipment itself. Simple resistance-capacitance networks are generally adequate and are similar to those used with semiconductor diodes. It should be noted, however, that transients which are not normally considered dangerous in such equipments might be sufficiently large in some instances to cause spurious firing of the controlled rectifiers, which may be undesirable. In avoiding spurious firing, it is essential to prevent pick-up or break-through of unwanted signals in the gate circuitry. This can be appreciable in unprotected and unscreened control circuits in the vicinity of apparatus operating at kilowatt power levels. This is a condition which can easily occur with silicon-controlled rectifiers when many kilowatts are being controlled by a few milliwatts.

Cooling

As with semiconductor rectifiers and power transistors, it is necessary to provide adequate means of cooling controlled rectifiers. The method of mounting is usually by means of a threaded stud on the body of the device, which is bolted thereby to a cooling fin for convection or forced air cooling, or to a water-cooled busbar.

The type of cooling and size of fin, where used, depends upon the application and environment, but the ultimate limiting factor is the temperature of the operating element, which usually has a limiting rating in the region of 100°C to 150°C. Fig. 10 shows typical cooling curves for the CS31 series of Trinistors when mounted on four different cooling fins.

(To be concluded)

MICRO-MINIATURISATION

TWO basic forms of micro-miniaturisation of electrical equipment were distinguished in an IEE lecture by Mr L. J. Ward, B.SC.TECH., A.M.I.E.E., delivered shortly before Christmas. One is the packaged circuit, in which components of preferably uniform size and shape are stacked in some uniform manner and interconnected. The other form is the integrated circuit, which uses manufacturing processes to form the circuit elements and the interconnections, these being formed *in situ* in the circuit unit. Thus the two forms have different central problems. For the packaged circuit, concern is with making component interconnections reliable. With an integrated circuit, the difficulty is to make a number of components, perhaps by different processes, in one unit.

Care when contracting

THOUGHTS ON MINOR—BUT COSTLY—ACCIDENTS

by F. G. Stevens,* A.M.I.E.E.

MINOR accidents while carrying out work in houses of the average suburban type can be costly in electrical contracting. They often occur through thoughtlessness or carelessness, so some consideration of them seems justified.

One of the most prevalent troubles is the scratching of furniture or walls. Scratched furniture usually has to be taken to a french polisher's shop, where it is likely to remain for some time. Such damage can be avoided by moving the furniture to a selected area which will enable the electrician to work without having to rearrange it several times. Unfortunately, this is not always possible, because people in small property will insist on buying furniture too large for their rooms, e.g., they may have a lounge suite consisting of a settee and two easy chairs, plus a showcase or cabinet, plus a TV or wireless set on a stand, plus a small table or newspaper rack, all packed into a room 11 ft by 10 ft. In a bedroom of similar size we find a double bed, plus a large wardrobe (with suitcases and shoe boxes on top), plus a chest of drawers; which reduces the working area to about a quarter. Moving lino, carpets and floorboards is a major job if the furniture is not to be marked or the lino torn, and a big handicap on a fixed (or estimated) priced job. The electrician starts off well, but often loses his temper and gets more and more careless as the obstructions mount up.

Another way in which avoidable damage occurs is through the need to deliver a washboiler, cooker or similar sized appliance to the front entrance of a terraced house in the middle of a block, in which the back entrance can only be approached down a long, narrow entry. The appliance has to be lifted, taken around sharp bends, across the living-room to the kitchen, and unless great care is taken furniture or walls are scratched and ornaments displaced and broken. Something of the same sort happens when an electrician, who is working on his knees in a bedroom, suddenly stands up and unhinges a dressing-table side mirror with his shoulder, causing disastrous results.

There seems no answer to these difficulties except to take care, which often means taking time.

Gas-pipe Punctures

Gas undertakings have always prided themselves on concealing as much of their work as possible, so many gas-pipe punctures can be excused: plaster and floorboards cannot be seen through. However, accidents can usually be avoided if care is taken (especially in old houses) to note the position of the gas meter, gas cooker and any other gas appliances or gas points, and try to visualise the gas-pipe runs before any electrical work or plugging walls, etc., is started. Should the electrician have any doubts, the main cock should be turned off, with the consumer's permission.

* Mr Stevens is contracting engineer, St. Helens district, Merseyside and North Wales EB.

Handling Floorboards

Special care must be exercised when lifting floorboards if damage is to be avoided. In older type houses, the square-edge floorboards are at least 1 in. thick; they are usually brittle with dryness and splinter very easily. Particular difficulty arises when it is a double boarding floor, the top boards being laid crosswise on the original floor. This involves a lot of non-electrical hard work and sometimes means the making of traps in the floor which have to be relaid and securely screwed in position before leaving.

New houses with the $\frac{3}{4}$ in. or $\frac{7}{8}$ in. tongue-and-groove type of flooring are not as difficult if a tonguing chisel is first used, or the special tools that are now available are applied to cut the boards and tighten them into position; this means that the original board will go back with the edges planed. Should the board split, it is advisable to replace the short piece completely.

Ceiling Plaster

A slip when working in the roof cock loft is not uncommon and since the depth of the ceiling joist is only about 4 in., the foot or knee easily comes into contact with the plaster. Ceiling laths soon dry and become brittle and will not allow for any extra weight, with the result that the plaster will crack and may soon fall off.

If a new ceiling plate or larger ceiling block is fitted it should afford some protection to a cracked ceiling, but the value of this is doubtful.

In the case of ceilings below floorboards, it is most unlikely that a slip will send any object through the ceiling. Since the depth of the floor joists is 9 in. or more, the knee or foot is not often brought into contact with the ceiling plaster, as in the cock loft. This suggests that it is fair to assume that most floor ceiling damage is due to carelessness.

Damage to Goods Delivered

When goods are being delivered, constant observation must be kept by the foreman or supervisor to see that there is complete harmony between the stores assistant, driver and any other people involved.

Extra care should be taken during the packing examination and transportation of all appliances from the stores department to the consumer; scratched or chipped enamel can prejudice a consumer against either the make of the appliance or the supplier, and this may take years to undo. No amount of pencil touching up will restore appearance or confidence.

Although the appliances may be firmly secured in the van, it is still helpful for the driver to take care that the minimum of bumping takes place on the journey.

On arrival at the consumer's house, a quick survey should be taken with the man in charge of the layout of

the premises and a decision made on the best route for delivery, either through the house or, if possible, around the back. New semi-detached or detached houses present few problems, as the back or side entry to the house can be used. Moreover, handling cradles and other specially designed modern appliances can be used and, above all, there is more room in the house.

Immersion Heater Installation

In old houses the plumbing presents certain difficulties, such as long runs of piping and excessive use of white lead and hemp around the joints. When these are broken, to empty any water from the cylinder, they can never be restored to the original state. By cleaning and replacing the hemp and using fresh white lead, acceptable efficiency can be achieved—but it needs care and patience. Other hazards are air locks from unusually long runs of piping, dust or fine dirt from the storage tank filtering through the pipes and causing blockage at sharp bends, etc.

None of these things occur in the new type of house, because the modern type of plumbing with new copper pipes helps considerably in the installation of the immersion heater. The modern builder in his wisdom, through the propaganda of EDA and other bodies, installs cylinders already flanged to accept the standard type of immersion heater and with a special cone-type fixing gland. This obviates any hot-solder plumbing and the shortest run of pipes is ensured, with stop cocks adjacent to the storage tank. This in itself eliminates most troubles.

Numerous other accidents take place that could be avoided. For instance, when an immersion heater is being fitted into a cylinder situated in a small bedroom or in a cupboard in the bathroom, the starting, pumping or relighting of a blowlamp inside may result in the flame spurting out and causing damage to furniture or walls. Blowlamps should always be lighted and pumped outside the house. When they go out they should be taken outside for relighting.

An electrician keen and anxious to get the job completed may not bother to carry a ladder from one room to another but may stand on a window ledge (with paper underneath)—and put his toe through a pane of glass. Or in lifting water heaters to fix into position on a wall he may allow the buttons of his overalls to scratch the enamel.

Basic Accident Causes

All the foregoing incidents have actually occurred in the author's district during work by conscientious and good craftsmen of average intelligence, most of them being occasioned by rushing.

In the nationalised electricity supply industry there is not the same authority over the men as in private contracting. If it was practicable the author would like to see introduced an incentive bonus or some other award, or better still a grading scheme by which the engineer would have authority to stop an award or downgrade or vice versa. This would show the conscientious man that he was appreciated and the careless worker that he should mend his ways.

Another expense that contracting has to bear arises from appliances under guarantee, for example cookers, in which the enamel chips around the hobs or around the doors within a matter of weeks of the original installation. The appliance has first to be examined to determine its condition, then the door or hob has to be ordered from the makers. The makers supply the damaged item free of charge, plus cost of delivery, but the contracting department have to stand the cost of the electrician's time, at least one hour, plus carriage one way of the faulty part to the makers to obtain the necessary credit.

The author has had a number of cooker, refrigerator and washing machine panels chipped which have had to be renewed. The makers supply the panel only, which in many cases means the appliance being returned to the workshop, for it is unreasonable to turn a consumer's kitchen into a workshop.

Recently the author has had experience of two immersion heaters perfectly installed in the hot-water cylinder by board craftsmen, which through an accidental fault in the manufacture allowed water to seep through to the head of the heater and cause a slight flood which marked the ceiling below. The contracting department had to change the immersion heaters and also compensate one of the consumers for damage done. In another instance, the water restricter screw on a wall-type water-heater screwed home so hard on the base of the tap on assembly at the makers that it was necessary to dismantle the whole tap from the heater to drill out the restricter—all at the contracting department's expense.

The time seems long overdue for an agreement between the contractors and the manufacturers for compensation to be paid to cover the type of emergency discussed on top of the discount allowed to contractors, which was originally meant to cover installation, transport and minor rectifications to the appliance.

European Energy Statistics

DETAILS of net generating capacity, fuel consumption and a detailed breakdown of electric power consumption for European countries and the USA is contained in the "Annual Bulletin of Electric Energy Statistics for Europe" for the years 1955 to 1959, published by the United Nations.

Highest energy production in Europe is recorded by the USSR at 264,020 million kWh during 1959, an increase of 55% since 1955. However, compared with the USA total for 1959 of 794,508 million kWh an increase of 29·26%, it is clear that there is ample scope for a further rise, and that this is likely is indicated by the higher rate of increase over the past five years. Energy production in the United Kingdom during 1959, at 114,629 million kWh, shows a rise of only 17% since 1955, and while West Germany lags slightly with generation at 96,471 million kWh, this figure reveals an increase of nearly 34% over the same period.

Turning to generating capacity, once again the USSR increase over the five years under review is the highest, having risen by 59% to 59,142 MW. This figure includes 12,600 MW of hydro generating capacity and 105 MW of nuclear plant. The USA generating capacity at the end of 1959 was 174,139 MW. Great Britain's total of 32,715 MW includes the highest nuclear generating capacity for any country, 259 MW. West Germany's total generating capacity rose in the five-year period by 34% to 23,385 MW and the corresponding figures for France are 32% and 18,958 MW.

The report also contains a detailed breakdown of energy consumption and international exchanges of power.

Corrugated seamless aluminium sheaths

FOR POWER CABLES

by D. McAllister*

ALTHOUGH aluminium has been well proven for cable sheathing, its use in Great Britain in recent years has been on a small scale and restricted primarily to a few designs of cable for which the technical properties of aluminium have contributed to a specific economic advantage, e.g., to withstand high internal pressures in super-tension cables and to provide good electrostatic screening for communication cables alongside electrified railways. In general, aluminium as a sheathing material has not been economically attractive, and a further factor limiting its use has been that the smooth profile died down sheaths which have mainly been employed are somewhat rigid and make the cables difficult to handle in confined spaces.

The adoption of corrugated seamless aluminium (CSA) sheaths provides good sheath-bending characteristics with reduced thickness of sheath, thus substantially changing the economic position and providing a cable which is easy to handle. Reduction in sheath thickness is made possible by the fact that the corrugation profile governs bending performance. In contrast, a smooth sheath kinks on bending if the thickness is inadequate and it is this which determines the thickness necessary. Fig. 1 shows a cable bent to a radius of six times its diameter, i.e., to one-half of the normal installation radius for paper-insulated power cables up to 11 kV.

* Mr McAllister is with British Insulated Callender's Cables Ltd.

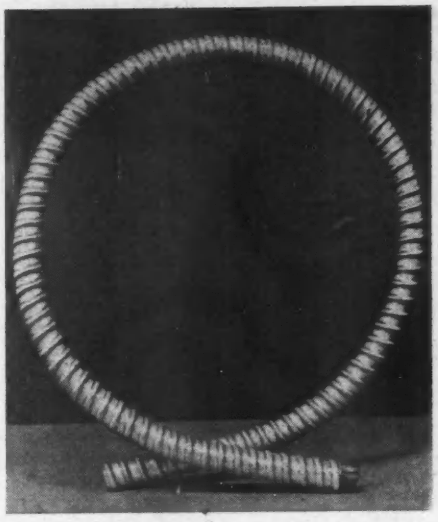
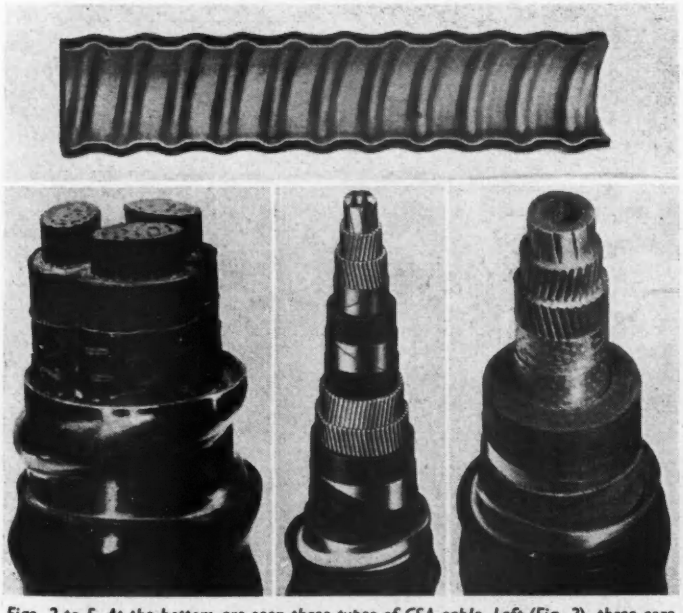


Fig. 1. CSA sheathed cable bent to a radius of six times overall diameter

The economic advantage offered by CSA cables is particularly attractive for 33 kV to 132 kV oil-filled cables, which require no reinforcement against internal pressure when aluminium-sheathed, and during the last 12 months there has been a substantial production of this type of cable (Figs. 2 to 4).

Table 1. Design data for CSA sheaths

Cable dia. over insulation	Sheath thickness (min.)	Pitch of corrugations	Rib height		
			Solid type cable	Single-core O.F. cable	3-core O.F. cable
in.	in.	in.	in.	in.	in.
0·5	0·025	0·7	0·09	—	—
1·0	0·034	0·9	0·14	0·09	0·11
2·0	0·049	1·1	0·205	0·13	0·155
3·0	0·061	1·3	0·28	0·18	0·21



Figs. 2 to 5. At the bottom are seen three types of CSA cable. Left (Fig. 2), three-core, 0·3 sq in. 33 kV ductless shaped-conductor oil-filled. Centre (Fig. 3), 0·85 sq in. earth concentric 25 kV oil-filled using aluminium conductors. Right (Fig. 4), single-core, 0·6 sq in. 132 kV oil-filled. In Fig. 5, above, is a cross-section of CSA sheath with p.v.c. oversheath

Profile and Dimensions

It will be seen from the cross-section profile of Fig. 5 that about one-half of the sheath is cylindrical, the other half being in the form of a spiral rib. This design is not a new one and has been used extensively in Germany for many years following the initial development work by the Osnabrucker Kupfer and Drahtwerk Company (OKD), from whom BICC have a licence. The design was chosen in preference to sinusoidal corrugation because of the merits of the smooth cylindrical bearing surface over the insulation, and because maximum bending strains occur in metal which has least work-hardening during manufacture.

The rib height is varied in accordance with the extent to which the finished cable is likely to be bent; more specifically, it is related to the bending test requirement on the particular type of cable, since this is often dependent on the insulation rather than on the sheath. In general, therefore, CSA cables are designed to have the same bending radii as lead-sheathed cables. Typical values of sheath thicknesses and rib heights are given in Table 1.

The short-time internal pressure required to burst CSA sheath is of the order of

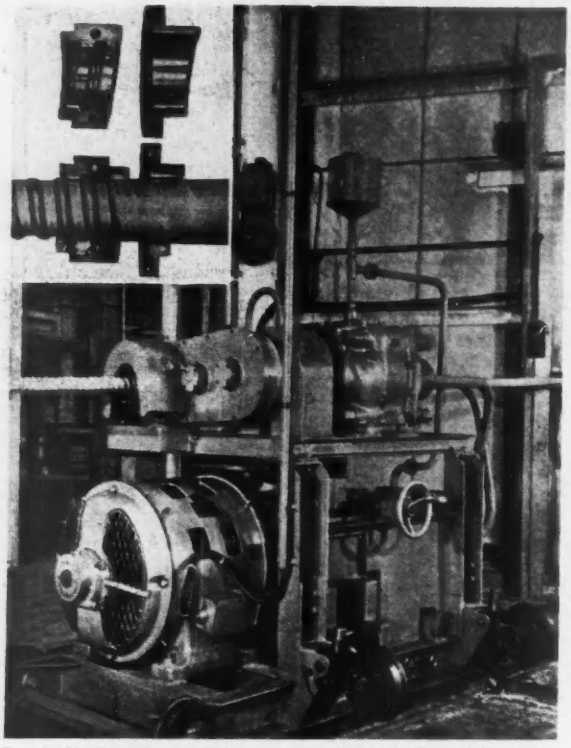


Fig. 6. Machine for producing corrugated sheath. Essentially it is a drive and reduction gear for rotating dies. One of the dies used in the corrugating head is shown in the inset, where formation of the corrugation is apparent. The right-hand die (the first) controls diameter over the rib

500 lb/sq in. (it varies with diameter), i.e., a hoop stress of 4½ ton/sq in. to 6 ton/sq in., which is characteristic of partially work-hardened aluminium.

Corrosion Protection

The abundant service experience with modern protective coverings has dispelled the doubts which at one time existed about the vulnerability of aluminium to corrosion. For CSA sheaths the use of an extruded p.v.c. oversheath is particularly attractive and is the recommended form of protection. Because of its excellent resistance to penetration, abrasion and attack by a wide range of oils and chemicals, p.v.c. has become an accepted standard for cable protection under onerous conditions, compliance with fire resistance requirement being an added feature.

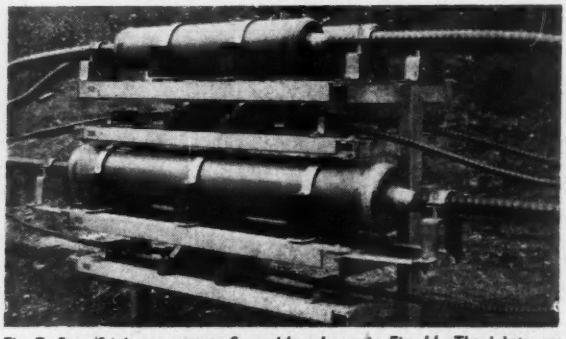


Fig. 7. Set of joints on posts for cables shown in Fig. 11. The joints are fully insulated with a p.v.c. sleeve to permit the p.v.c. oversheath on the whole cable route to be voltage tested from time to time

By using a vacuum technique during extrusion, the p.v.c. is sucked down to make intimate contact with the aluminium surface (Fig. 5), and as a secondary safeguard against the possibility of water penetrating under the p.v.c. due to severe mechanical damage, a layer of bitumen containing a corrosion inhibitor is applied between the aluminium and the p.v.c. The outer surface of the p.v.c. is coated with graphite to provide an electrode, so that the quality and integrity of the covering can be checked after manufacture, again after installation, and, if required, continuously throughout the life of the cable.

P.V.C. oversheaths have been the primary standard for cables in collieries and in British oil refineries for over five years, and have an eminently satisfactory record. In addition, they have been used on CSA sheaths in Germany over a similar period, with successful experience on nearly 2,000 miles of cable.

Manufacture

At the Erith works of BICC, CSA sheaths are made by the simple substitution of a corrugating head for the sinking die in the plant used for died down sheaths. Pre-extruded pipe is pressure-tested on the drum, and is then laid out straight on a gantry 525 yd in length. The cable core is pulled into the tube and the corrugations are formed by feeding the cable through a set of rotating dies (Fig. 6). The first die swages the tube to give the required diameter over the ribs and the second die forms the helical flat between the ribs, the tube being well coated with lubricant as it enters the die.

Applications of CSA Sheaths

On the Continent, and in Germany in particular, CSA sheaths have found their main application for high voltage oil-filled cables and for telephone cables, where screening is required, although there has also been some use for low-voltage power cables, employing the sheath as a neutral conductor. In Great Britain, utilisation on telephone cables is only just beginning, an obvious application being for cables alongside railways electrified at the standard frequency. The main interest has been for high-voltage oil-filled cables, reliability with maximum economy providing the incentive. A contract of particular interest is a 132 kV circuit for the Central Electricity Generating Board using three single-core 0·6 sq in. cables with the sheaths cross-bonded and comprising 19 miles of cables. Installation is

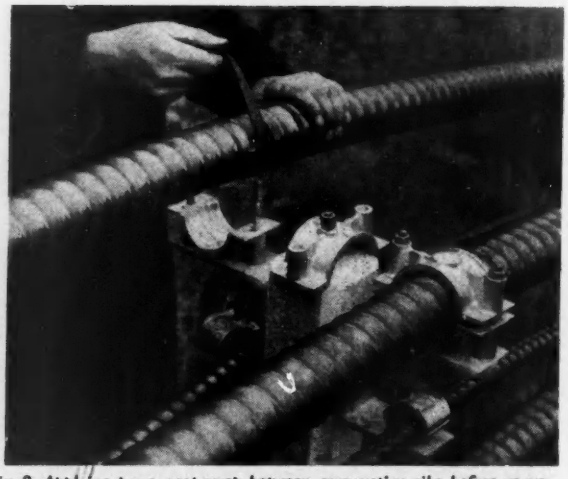


Fig. 8. Applying p.v.c. root-wrap between corrugation ribs before securing cable in cleat. This avoids the whole weight of the cable resting on the portion of the rib within the cleat

almost complete and cables for other similar contracts are in manufacture. Installations of 25 kV concentric and 33 kV three-core cables are described later.

If non-draining type insulation is used, CSA sheaths can be employed satisfactorily on low- and high-voltage solid-type power cables to provide a light-weight cable at economic cost which is particularly easy to handle in confined spaces and has excellent mechanical strength and resistance to vibration fatigue. These qualities are particularly favourable for above-ground installations in which situations support spacings can, as shown below, be greatly increased with consequent savings in construction costs.

Typical Installation

The advantages of CSA sheaths discussed above are well illustrated in two recent installations over similar routes in connection with power supplies at Shenfield, Essex, for the conversion to a.c. of the Liverpool Street to Southend Victoria and Chelmsford railway electrification scheme.

Some 3,500 yd of 25 kV earth concentric cable, comprising two circuits, was installed for the Eastern Region of British Railways. The cables, which provide power to Shenfield traction feeder station, are each connected to a 132/25 kV, 15 MVA transformer at the CEGB Shenfield substation. As the railway electrification is a voltage-conversion scheme, the Eastern Electricity Board were also involved in the transmission modifications and required 33 kV three-phase cable, part of which had to follow the same route. The length of cable involved was 16,000 yd.

The 33 kV cable follows the now-familiar pattern for ductless, shaped conductor oil-filled cable (DSO) shown in Fig. 2.

The 25 kV concentric type of cable is also well established for railway electrification, and with the new form of sheath the most remarkable aspect of this cable, with its large (0·85 sq in.) aluminium conductors (Fig 3), is that in spite of the high proportion of metal in the total volume of the cable, the overall weight is only 13 lb/yd.

Conductor sizes and dimensional details of the cables at Shenfield are shown in Table 2.

Alongside railway tracks, where cable-laying must be done to a rigid time-table, ease and speed of handling are vital. The cables concerned were all laid easily and without incident, some from trucks moving along the line, others using a small power-winch with the drum mounted near the line (Fig. 9).

The most noteworthy feature is the installation on posts (Fig. 11) which was used for the cables alongside the railway. Away from the track the cables were either buried direct or pulled into ducts. Most of the post-runs contain three circuits of main cable, each with its pilot cable (also CSA-sheathed), and the post spacing is 15 ft. This spacing was chosen primarily for technical reasons, because the generous span absorbs expansion and movement of cable across the posts. However, at the same time it enables appreciable additional savings to be obtained, the low weights of the cables being a contributory factor. Following the principles laid down by Holttum,[1,2] the wisdom of increasing spacing beyond the conventional 3 ft to about 6 ft to 8 ft for the average run of lead-sheathed cables has by now become generally accepted; indeed, for large conductor single-core cables with cyclic loading to maximum permissible temperatures it has been shown to be necessary if sheath fatigue failures are to be avoided. With the CSA sheath this figure can safely be extended to 15 ft. At first there were misgivings that 15 ft spacing would inevitably be untidy and unattractive compared with the usual appearance, and it is pleasing to see that although modern ideas have changed the pattern, symmetry and neatness of line are unimpaired. With this in

Table 2. Details of cables used in Shenfield scheme

Type of cable	Sheath thickness	Rib height	Diam. over sheath ribs	Diameter overall
	in.	in.	in.	in.
33 kV three-core				
0·35 sq in.	0·056	0·155	2·53	2·81
0·4 sq in.	0·056	0·155	2·63	2·91
0·5 sq in.	0·059	0·155	2·78	3·06
0·55 sq in.	0·059	0·18	2·91	3·19
25 kV concentric				
0·85 sq in.	0·059	0·155	2·58	2·91

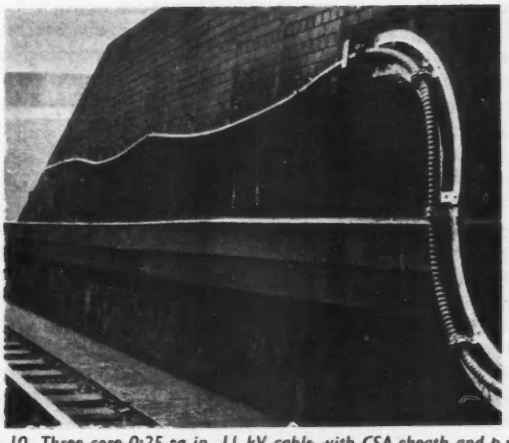


Fig. 10. Three-core 0·25 sq in. 11 kV cable with CSA sheath and p.v.c. oversheath mounted on hangers at 15 ft spacing

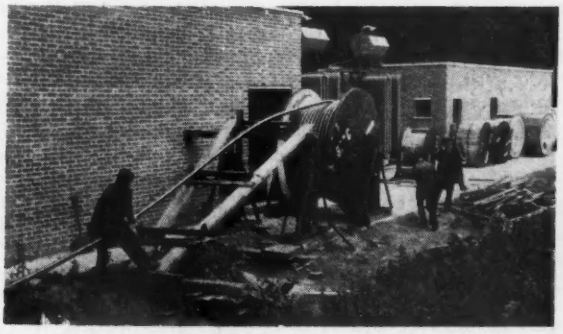


Fig. 9. CSA three-core oil-filled cable being run out on a drum at a sub-station. A small power-winch is used to pull the cable

Fig. 11. One circuit of three-core 0·35 sq in. 33 kV cable and two circuits of 0·85 sq in., 25 kV earth concentric cable, each with pilots, on post route with 15 ft spacing

mind, the pilot cable has been cleated at the same wide spacing as the power cable, support being given to the pilot from the power cable at mid-span.

Fig. 8 shows the method of cleating to avoid the whole weight of cable resting on the portion of the rib within the cleat. A pre-shaped p.v.c. strip is used to fill the trough, the thickness of the strip being slightly greater than the height of the rib. Joints on post sections are illustrated in Fig. 7.

Plumbing at joints to CSA sheaths is virtually the same as for smooth aluminium sheaths, the sheaths being pre-tinned by the friction technique and then a wiped plumb applied normally.

Fig. 10 shows 11 kV solid cable installed elsewhere by British Transport Commission, at 15 ft spacing on a wall.

Acknowledgments

The author would like to express his thanks to the chief engineer of British Insulated Callender's Cables for permission to publish this article; also to the Eastern Electricity Board and British Transport Commission for their agreement to the inclusion of details of the contracts described.

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GLASGOW TRAINS INQUIRY

TO put a finger on the exact cause of the recent series of transformer failures on Glasgow's electrified suburban railway had posed a difficult problem for BTC technical staff. This was apparent from the evidence given by Mr J. A. Broughall, electrical development engineer, BTC, on the second and last day of the public inquiry held just before Christmas. The effects of the failures had been described on the previous day by Mr S. E. Raymond, assistant traffic manager, BR, Scottish Region, and other witnesses. There had been, in all, five mishaps following a basically similar pattern. All incidents involved six-car trains (made up of two standard three-car multiple units). In each case a transformer had become badly overheated following manual re-setting of the corresponding main circuit-breaker while the train was running, the breaker having previously tripped-out due to causes unknown. The resultant generation of vapour at high pressure from the transformer oil had, on every occasion, caused damage to the transformer tank and conservator.

In the first incident, occurring on 30 October, there was an explosion in the empty guard's van of a train on a trial run just before the new service was inaugurated. The explosion was thought to be due to the ignition by an electric spark of a mixture of hot oil-vapour and air occurring in the oil conservator compartment which is mounted in the guard's van. Another witness, Mr F. Whyman, general manager, AEI Traction Division, said that in his opinion the temperature of the oil in the transformer had been sufficient to cause "cracking" with the formation of free hydrogen.

Questioned by Brig. C. A. Langley, president of the court, as to how oil-vapour had got into the conservator compartment, Mr Broughall said that the pressure of the oil-vapour was assumed to have forced open the cover of the conservator, allowing vapour to escape. Following this accident, the BTC had sought to prevent a recurrence by fitting a vent pipe to the top of the conservator to relieve excess vapour pressure. This was purely a safety measure in the interests of the guard and passengers.

That the initial modification to the conservator was inadequate was proved by a second explosion in the guard's van of a train, this time near Renton station on 13 December. Following this, further modifications were carried out whereby the pipe leading from the transformer tank to the conservator was constricted to limit flow of hot oil-vapour and two ventilating holes made in the conservator compartment. There were then two further cases of transformer overheating, without explosions, but causing such severe damage to the transformer, particularly in the final incident, that it was decided to withdraw all trains from service.

In his evidence, Mr Broughall said that after the second incident on 14 November, the BTC decided to withdraw four transformers, including the oldest, for examination by the makers, AEI, Manchester. They were surprised to find that results of the examination gave no indication of these transformers being in any way faulty. Examination of the damaged transformer after the first incident, at Charing Cross, had shown the secondary winding to be badly overheated, the primary being unaffected. Significantly, the BTC had been entirely satisfied with tests carried out on the original prototype; furthermore, no trouble had been experienced with transformers during the trial running period which had extended over a period of 16 months. Similar equipment, but without the dual voltage primary, had been in successful use abroad. There had been no history of transformer failures on h.v. a.c. electrified lines elsewhere in the country. Comparing the Glasgow stock with that used on BR Eastern Region electric services from Liverpool Street, Mr Broughall said that, despite similarities, there were differences that might prove vitally significant.

Adjourning the public inquiry, Brig. Langley said that technical investigations would continue in private and that a report would be published as soon as possible.

Technical Particulars

The following are brief details of the transformers and ancillary equipment used on Glasgow multiple-unit stock. The transformer is centrally disposed in the motor-coach and mounted on the underframe. It is connected to the pantograph, via an air blast circuit-breaker mounted on the roof of the guard's van, by means of a vulcanised rubber insulated cable with an embedded earthed screen. The transformer, having a primary rating of 25/6·25 kV, 970 kVA, has a tank divided into two compartments, one of which houses the core and windings with l.t. terminals mounted at the tank end-wall. The h.t. cable terminal and 7-pole, 2-way primary changeover switch are mounted in the second compartment. The oil in this latter chamber does not circulate, performing an insulating function only. The oil in the main compartment is circulated at 50 g.p.m. through a fan-cooled Serck radiator capable of dissipating 26 kW. The oil conservator, fitted with a silica-gel breather, is situated some distance away, in the guard's van.

AROUND THE TRADE

BY PEREGRIN

JUST a few days into 1961 and already from a star-spangled, holly-wrapped Christmastide we have stepped into the dull, depressing days of inquests on last year's turnover, stocktaking, future plans, tales of past mistakes, and a few bold resolutions for this brave new year. Looking back over 1960, I find the final results far better than I expected and, in spite of the credit squeeze and the purchase tax, Christmas trade reached a new peak and my bank manager sent me a calendar! Yet it was small stuff that sold: refrigerators, washing machines and vacuum cleaners hardly stirred—or television for that matter—but lighting fittings, shavers and blankets went like hot cakes.

On the contracting side we were stretched to the limit, so that a day's illness of any one man was a major disaster, and we were so burdened with appliance repairs that I wished I had the courage of some traders who refuse all repairs from three weeks before Christmas.

Contractor-Board Co-operation

1961 is off to a good start with the increase in electricians' pay to 6s 2d, and corresponding increases for the lesser fry. This increase was definitely a good resolution on the part of the powers that be, long overdue after the leap ahead some two months ago of the area boards' wages. Dare I prophecy—I can at least hope—that this playing off the Boards against the Contractors by the ETU will soon be scotched? Surely the relationship between electricity boards and the ECA has reached the stage where they could negotiate together more economically and satisfactorily all round.

It is sad news that some areas may once more be faced with load shedding, but we are comforted a little by the thought that the afflicted may only suffer for half an hour at any one time. This handled the right way could be used to help the night-load-floor-heating cause and it would be pleasant to hear of the VIPs' resolve that in 1961 there should be co-operative advertising by EDA and the ECA on such matters—they could even throw in the EAW for make-weight. It might do much to compete with the efficient and telling publicity issued by the oil manufacturers to boost their central heating scheme. Indeed, I would like to see this year bring forth more co-operation between the boards and the ECA all round. Concerted, co-operative effort could be extended to cover most aspects of the trade with more benefit to trade and public alike than the spirit of rivalry and "exclusiveness" which rapidly developed in 1960—particularly on the part of the boards—brings forth.

Trading In Control

I was glad to see, as we ploughed damply through 1960, that, in spite of the RTP Act undermining public confidence in our trade, several manufacturers supported retail price maintenance—Ferranti and Hotpoint among them. Hotpoint state "the success of our policy depends on the support you, and the trade as a whole, give us." How very true! This panic slashing of prices whenever trade falls off a little is deplorable, and the retailer with his rising overheads and fixed margins, is playing a dangerous game when he indulges in it. The latter part of 1960 was notorious for price slashing and the press soon made capital out of it. One Sunday newspaper pin-pointed a 10 gn reduction on a 63 gn refrigerator; a £37 allowance on an old washing machine; and a spin drier free with a reconditioned Hoover washing machine and so on. That is, of course, all due to over estimation of the available market, bad buying, and too much high pressure salesmanship by manufacturers' representatives. Certainly not all the faults are on the retail side. Stock shedding, like load shedding, wants careful planning, and manufacturers should ensure that retailers have a fair chance to dispose of stocks, or a fair allowance on discontinued lines, before they dump their surplus at a fantastically low price on one of the big stores. Sometimes to dump on the scrap heap is the soundest policy of all!

It is a pity that the Fair Trading Council is no longer with us, but I hope this bright new year will put some bright new thoughts into the heads of those who met last October at Mr T. W. Heather's invitation and achieved nothing more than to damp the ardour of those seeking a substitute to protect their interests and those of the public.

Which reminds me of rumours that an erstwhile director of an R. and TV association is starting up a new association for electrical retailers. How foolish can we get? The present position of the trade calls for the utmost unanimity and co-operation, not for a splitting of loyalties and effort. There is room for only one such association in this country successfully to protect and further retail interests, and we already have it, well established, and working hard with its sound committee and common sense chairman under the wing of NECTA and the inimitable LCP. I prophecy that during 1961 this association will go from strength to strength—and I *hope* they will improve the brochure.

Appliance Approval

I see that the British Electrical Approvals Board is to be launched next month to set its seal of safety on electrical appliances. So far so good; this is a step in the right direction. But why not extend it to cover "fitness for purpose" as well. Safety is not everything in an appliance: so many articles do not fulfil their functions satisfactorily, nor give the term and degree of usefulness that the public has a right to expect. Some standard should be set up, for, if we are to credit the findings of *Which?*, top price does not necessarily mean top value or top efficiency. The Board could also take note of suitability for public handling. Machines tested by trained staff and demonstrators will not always stand up to the "Came to pieces in my hand, mum" type of char. One thing, however, is certain, we do not want another new mark. I had honed this new Board would settle for a modified Kite mark. One final thought with which to start the year—what about an Electrical Appliance Fair for 1961?

Pumped-storage in Austria

TWO years of successful operation at the Latschau Power Station of the Lünersee development in Austria has demonstrated how a high-pressure pumped storage generating station working with thermal stations contributes to production and utilisation of energy.

This power station was officially inaugurated in March, 1958, as part of the Austrian electricity company Vorarlberger Illwerke A.G's extension to its "Obere Ill" power plants. With an installed turbine capacity, at present, of 224 MW and a pump input capacity of 252 MW, this station has the highest rating of any in Austria, while the high-pressure pumped-storage plant, with a gross mean head of 3,209 ft, is claimed to be the largest in the world. The station is connected to the West German grid, which supplies energy to large areas of Austria, Switzerland and Germany. It absorbs the surplus power of the coal and lignite-burning power stations in the Rhineland and, in return, generates valuable peak power. This co-ordination enables the large Ruhr power stations to be kept running at high load overnight and at week-ends, with consequent improvements in their economy and utilisation. The main function of the station is to provide summer storage between May and August in preparation for the winter demand, but the Lünersee plant is also used for short-term storage purposes throughout the year and a daily, weekly or monthly variation in the water level of the reservoir is superimposed upon the main annual cycle.

Water Source

The Vorarlberger Illwerke uses, for hydro-generating purposes, the waters of the Montafon Valley between Bludenz and the Silvretta group of mountains. The Lünersee reservoir serving the system is a natural Alpine lake located at 6,460 ft elevation in the Scesaplana chain near the Swiss frontier. Its natural capacity was 1,400 million cu ft of water, but this has been approximately doubled by the construction of a comparatively small gravity concrete dam 1,247 ft long and 92 ft maximum height. The catchment area of the lake has been increased from 3·4 sq miles to 4·7 sq miles by intercepting the water from the adjacent valley of the Brandon glacier. As the natural run-off into the lake is still only about 600 million cu ft per annum, the remaining 2,100 million cu ft has to be pumped up from the River Ill near Schruns.

Fig. 1 (above). General view of the Lunersee pump storage area

To the point where the water is returned from the River Ill, the available drop from Lünersee totals 4,350 ft. This was exploited in a first step of 3,210 ft between Lünersee and the Latschau power station and a second stage with a gross head of 1,140 ft between Latschau and the lower Rodund power station. From the Lünersee, the water is taken through two rock tunnels, which are connected by a steel tube siphon below an intermediate valley, to a surge tank at Grüneck. Thence, it drops through a penstock to the turbines of the Latschau station. After use, the water is temporarily stored and supplemented by water from adjacent valleys before being passed down the penstock to the Rodund station. It is from the Latschau storage basin that the water is pumped back to Lünersee at a maximum rate of 93 cu ft per second.

Hydraulic Distributors

From the pressure shaft serving the Latschau power station, the water passes through a distributor connected to the turbine and pump inlet pipes. An auxiliary distributor serves a general-purpose turbine and turbines driving the transfer pumps. The whole of the flat section of the pressure shaft to the connection with the distributor is laid in rock, with wall thickness increasing as the rock cover diminishes. At its bottom end, this pipe is fitted with two anchorages for the freely supported, open distributor, which is of a special design developed by Sulzer Brothers.

The distributor's six branches fork after the isolation valves and lead thence to the pumps and turbines. For the fabrication of the $2\frac{9}{16}$ in. thick high-tensile steel plates, submerged-arc-welding was used and the welds tested by an ultrasonic method developed by Sulzer Brothers and which has been adopted in their plant for the inspection of all welds in lieu of hydraulic pressure tests.

Six vertical sets, each consisting of motor/generator, turbine, hydraulic torque converter and pump, have been planned for the Latschau station and five of these have so far been installed. The turbine output is 353 million kWh and the pump input 536 million kWh a year.

Each of the Pelton wheel turbines is rated 54,400 h.p. at 750 r.p.m. with a mean head of 2,875 ft and a maximum

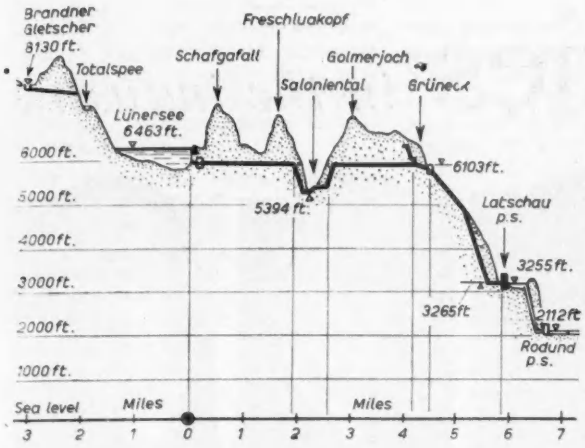


Fig. 2. Representation of the water course for the Latschau and Rodund hydro stations. The pumped storage plant is at Latschau

water throughput of 195 cu ft/sec. Two were made by J. M. Voith and three by Escher Wyss. The Pelton house-generator, made by Maschinenfabrik Andritz is rated 2,400 h.p. at 1,500 r.p.m. with a mean head of 2,875 ft and a water throughput of 9 cu ft/sec. Two of the associated 56 MVA, 10·5 kV, 50c/s generators were made by AEG and three by Elin. The latter firm also made the 2·2 MVA, 400 V, 50 c/s station generator. The main high-pressure, five-stage storage pumps are rated 55,400 h.p. at 750 r.p.m. with a mean head of 3,190 ft and a maximum delivery of 179 cu ft/sec. Two were made by J. M. Voith, two by Escher Wyss and one by Sulzer Brothers. All the torque converters were made by J. M. Voith and have a rating of 32,000 h.p. These, combined with disconnectable, toothed couplings, are fitted between the turbine and the pump.

The torque converter permits the pump to be accelerated to synchronous speed with the turbine and generator running and the annular pump discharge valve closed. The pump can be engaged when it attains running speed. This greatly speeds up the changeover from turbine to pump operation, or vice versa, and can be carried out while the upper part of the set is turning at full speed. A self-closing, angle-fitted annular valve made by Charmilles, placed between pump and discharge pipe, is designed to allow for any unexpected shut-down, as well as for normal starting and stopping.

The pump is always filled with water and the hydraulic coupling enables it to be disengaged after every period of operation without regard for the upper part of the set, even when it is intended to shut-down the set as a whole.

The operator has push-buttons selecting automatic sequencing for the control of turbine and pump operation. The turbine control sequence provides for start-up of the turbine by opening the spherical inlet valves and nozzles, after the isolating valve has been opened. When synchronous speed has been attained the set is synchronised and adjusted to transmit the required power to the distribution network.

To change over to pump operation with the turbine running, the hydraulic torque converter guide vanes are opened and the casing filled with water. The pump accelerates and a toothed coupling engages into the generator/motor shaft when the slip is less than 1%. The pump valve then opens and the torque converter casing is emptied. During this changeover, the generator/motor field is automatically regulated to give motor operation.

To shut down the pump, the annular discharge valve is closed and water admitted to the torque converter casing. The toothed coupling is disengaged, water expelled from the torque converter and the guide vanes closed. The pump is now disconnected from the generator/motor and comes to rest. Subsequently, the generator/motor line and field circuit-breakers are opened to bring the set to rest.

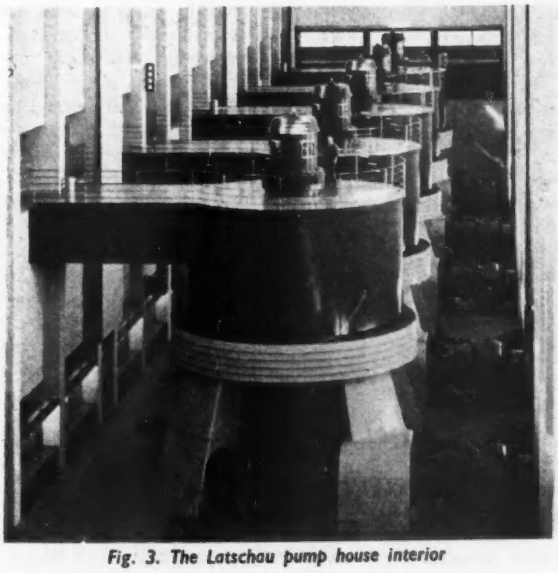


Fig. 3. The Latschau pump house interior

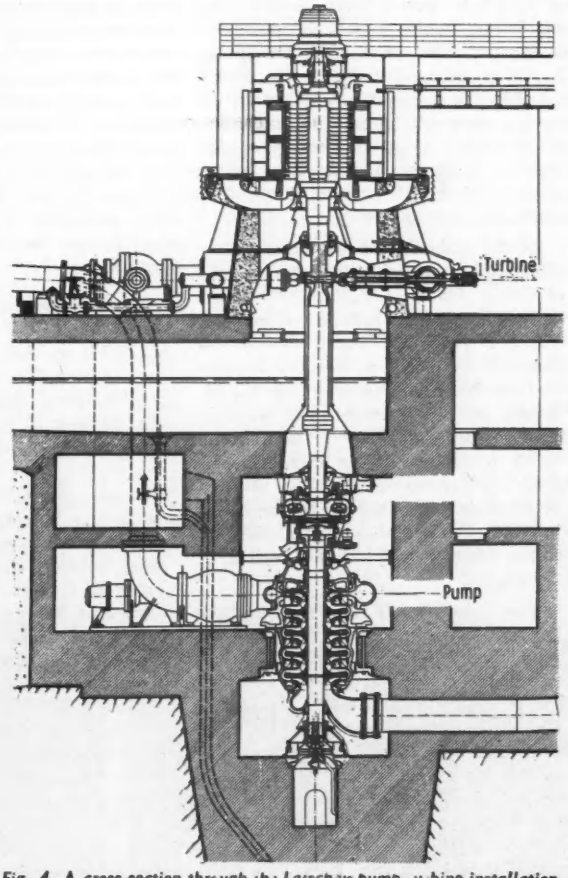


Fig. 4. A cross-section through the Latschau pump-turbine installation. The pump connection is made to the generator/motor near synchronous speed through a toothed coupling. It is accelerated by a hydraulic torque converter

Personalities *in the industry*

Mr F. Linley

Mr David Brook

Mr J. D. Riddle

Mr R. Evans

Mr L. C. W. Turner

The new deputy chairman of the North Western Electricity Board is **Mr F. Linley,** M.I.E.E., A.M.C.T., who has been a member of the Board since Jan., 1959, and is also manager of the Board's No. 1 sub-area. He succeeds **Mr T. Coates,** M.ENG., M.I.E.E., M.I.MECH.E., who resigned on his appointment as general manager of the British Egg Marketing Board (which we noted on 1 Dec.). (*ESH, page 155.) Mr Linley has been manager of the Board's No. 1 sub-area for the past seven years, following some six months as purchasing officer. Prior to nationalisation of the industry he was chief assistant mains engineer of the Manchester Corporation electricity undertaking.

At the end of 1960 **Mr John Bailey** relinquished his position as sales director of Brook Motors Ltd., but he remains on the board as a technical consultant. From 1 Jan., **Mr David Brook** has assumed the position of sales director for the home market and **Mr G. H. Brook,** as sales manager, will work in close liaison with him. Mr David Brook served his apprenticeship with the company and occupied an executive position before being co-opted on to the board in 1958. He is also a council member of the Huddersfield Junior Chamber of Commerce.

Two new deputy chiefs have been appointed by the North Western Electricity Board—**Mr E. Kirkland,** A.M.I.E.E., as deputy chief engineer, and **Mr G. A. W. Riley,** A.I.M.T.A., A.C.I.S., as deputy chief accountant. (*ESH, pages 155 and 156.) Mr Kirkland was previously acting district commercial engineer for the Board's Macclesfield district, but before going there early last year had been in charge of the Organisation and Methods section at Board headquarters. He started with the Manchester Corporation Electricity Department in 1927 as a testing assistant and by 1948 had become assistant engineer (transmission). Since then he has served in engineering appointments in the Board's North West District and at No. 1 sub-area. During the war he served in the RA, the RAOC and REME, being demobilised with the rank of major. Mr Riley has been with the Board at headquarters since 1948, being section head (salaries, wages and superannuation) from 1949—a post which was later designated assistant chief accountant (salaries and superannuation). He became responsible for accountancy methods last year. Prior to 1948 he was a principal assistant in the Manchester City Treasurer's Department. He served in the Intelligence Corps and the RASC during the war, holding the rank of captain.

The turbine factory at the Rugby works of AEI has now been incorporated in the AEI Heavy Plant Division and renamed "Large Machine and Compressor Dept." **Mr J. D. Riddle,** who was manager of the turbine factory, has been appointed manager of this new department, with **Mr R. Evans,** B.SC., who was superintendent of large machine production in the heavy plant factory, as assistant manager. After receiving his early technical education at Rutherford Technical College, Newcastle, Mr Riddle studied at Bournemouth Municipal College and Imperial College, London. He served his apprenticeship at C. A. Parsons and Co. Ltd. and, after a short period with Aish and Co. Ltd., Bournemouth, joined BTH in 1949 as a design engineer in Rectifier Engineering Department. Two years later he transferred to Turbine Methods Development. In 1956, Mr Riddle became assistant superintendent of the Turbine factory and was appointed superintendent in 1958. A year later he succeeded Mr J. S. Borrington as manager of what was then the Turbine factory. Mr Evans received his education at Tregaron County School, this being followed by a three-year course in electrical engineering at University College, Cardiff. In 1928 he joined the BTH Co., now AEI (Rugby) Ltd., in the Test Department at Birmingham works. In 1933 he was transferred to Generator Test, Rugby works, being promoted test foreman six years later. He was appointed assistant superintendent of the generator factory in 1949 and superintendent in 1957, the position he held until his present appointment.

General manager and a director of Aircraft Marine Products (Gt Britain) Ltd., **Mr L. C. W. Turner** joined the board of Thomas Bolton and Sons on 1 Jan., and assumes the position of general manager as from that date. **Mr W. F. Slater** relinquished his appointment as general manager on 31 Dec., but will continue as a director with special duties. Prior to joining Aircraft Marine Products in January, 1959, Mr Turner was sales director of the Brush Electrical Engineering Co. Ltd. with whom he served for five years. Earlier he was with Crompton Parkinson Ltd., gaining his training with that company, and then serving as sales engineer in London and Birmingham from 1935 to 1939. After the war he was a switchgear specialist with CP, operating from London until 1949, when he became manager in Northern Ireland for the company. He was afterwards manager of the company's Plant Division in the north west area from 1950 to 1954 when he joined Brush.

Engineer of the Ayrshire area of the South of Scotland Electricity Board since 1949, **Mr L. Harvey,** M.I.E.E., has been appointed manager of the Board's Glasgow area (*ESH, pages 165 and 168).

(**Denotes revision to the "Electricity Supply Handbook, 1960."*)

Prior to joining the South of Scotland Board, Mr Harvey was sub-area construction engineer with the Merseyside and North Wales Electricity Board, having earlier served with the North Wales Power Co., from 1931, latterly as construction engineer.

Mr Charles W. Villiers has been appointed to the board of Morphy-Richards (Cray) Ltd. He joined Morphy-Richards as purchasing manager when the company was first established 24 years ago. As a director of Morphy-Richards (Cray) Ltd. he will retain full executive responsibility in charge of the Purchasing Division.

Mr P. R. Armitage, A.M.I.LOCO.E., has been appointed manager of the Traction Division of the General Electric Co. Ltd. in succession to **Mr W. D. Morton,** whose promotion to assistant general manager of the Witton works was announced recently. Born in Birmingham in 1926, Mr Armitage was educated at King's Norton Grammar School and the Birmingham College of Technology. He joined the company in 1942 as a premium apprentice and was appointed a traction control engineer in 1946. Mr Armitage has spent the whole of his time in the Traction Division and has worked in the Control Department and in the Sales and Contracts Department.

Mr J. J. Gracie, C.B.E., M.I.E.E., has accepted an invitation to join the board of The Mint, Birmingham, Ltd., in place of **Mr O. A. Pallet** who has resigned.

The Italian Ambassador, Signor V. Zoppi, presented **Sir John M. Duncanson,** president of the Institution of Nuclear Engineers, with a gold medal in a ceremony at the Italian Embassy on 2 Jan. The medal was awarded to Sir John by the Rassenga Internazionale Elettronica e Nucleare for "outstanding services in the field of nuclear energy." The award is known as the Scientia et Divulgatio.

In view of the expansion of the Weir Group, **Viscount Weir,** C.B.E., chairman of G. and J. Weir Holdings Ltd., is giving up his position on the board of the principal subsidiary company, G. and J. Weir Ltd., in order to devote more time to the overall administration of the group. **Mr J. Russell Lang** takes over the position of chairman of G. and J. Weir Ltd. and is succeeded as managing director by **Mr J. W. Atwell,** M.SC. **The Hon W. K. J. Weir** is joining the board of G. and J. Weir Ltd. as an additional director. Viscount Weir is also resigning from the boards of Weir-Catton Ltd. and Weir Foundries Ltd.

Mr S. E. Clotworthy (managing director of Alcan Industries) has been elected chairman of the Aluminium Industry Council in succession to **Mr H. G. Herrington** (managing director, High Duty Alloys).

Following the retirement of **Mr H. M. Lacey** on 30 Sept. last, **Dr R. H. Golde,** D.SC., M.I.E.E., has been appointed head of the Surges and Transformer Department of the Electrical Research Association and **Mr M. Waters,** B.SC., M.I.E.E., is now deputy head of that department. Dr Golde is known internationally for his work on the lightning performance of high-voltage systems and lightning protection of installations. He has lectured at Universities, scientific institutions and engineering societies in Great Britain, France, Sweden, Austria, Poland and Italy. He is the author of publications in the British, American and Continental technical press. In co-authorship with Dr C. E. R. Bruce, of the ERA, he was in 1941 awarded the Kelvin Premium for their paper "The Lightning Discharge." Dr Golde is also secretary of the Study Committee on Lightning and Surges of CIGRE, a member of the International Committee on Lightning Protection and of several BSI, IEE and IEC Committees. He was educated at the Technical University of Berlin, joined the ERA in 1935, and took his Ph.D. degree at Queen Mary College, London, and was awarded the D.Sc.(Eng.) by the same University. Mr Waters received early training with A. Reyrolle and Co. and during his apprenticeship there he won the scholarship of the North East Coast Institution of Engineers and Shipbuilders, which enabled him to proceed to King's College, Durham University, where he graduated with first-class honours in electrical engineering. Mr Waters returned to Reyrolle's, working in the Research Department, and after subsequent experience in power station construction with Parolle Electrical Plant Co. Ltd. he joined the ERA in 1946 to undertake research on power transformers. Mr Waters is co-author of "Neutral Grounding in High Voltage Transmission" and of two IEE papers, one of which was awarded the Sylvanus Thompson premium. Internationally he is best known for his work on electromagnetic forces in transformers.

Assistant secretary (administration) to the North Western Electricity Board, **Mr H. W. Buxton,** F.C.C.S., M.P.O.A., is retiring on 2 March and is to take up Holy Orders (*ESH, page 155). A lay reader at New Moston, Manchester, for the past 16 years, he will enter Lincoln Theological College for a short period for pre-ordination training. Mr Buxton entered the electricity supply industry in 1920 with the former Manchester Corporation undertaking and at vesting day was management secretary. He is 57.

Mr A. C. T. Frantz, A.M.I.E.E., has been appointed assistant city electrical engineer of Cape Town, South Africa, in succession to **Mr E. G. Ivey,** B.SC.(ENG.), A.M.I.E.E., who recently retired.

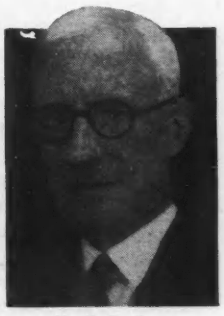
Mr F. D. Pratt, personal assistant to **Mr G. S. C. Lucas** O.B.E., director and chief engineer, AEI (Rugby) Ltd., retired on 23 Dec. after nearly 52 years' service with the company. Educated at Walton-on-the-Naze, where he was born, and at Rugby College of Further Education (now Rugby College of Engineering Technology), Mr Pratt joined the BTH Co., now AEI (Rugby) Ltd., in the main drawing office. After completing drawing office and works apprenticeships, he returned to the Main DO in 1917. During the war he was with the Admiralty as assistant designer on submarine mines at the Mining School, Portsmouth, attached to HMS *Vernon*. In 1919 he returned to the Generating Section Turbine DO and, two years later, was transferred to the then Turbo-

Mr C. W. Villiers

Mr P. R. Armitage

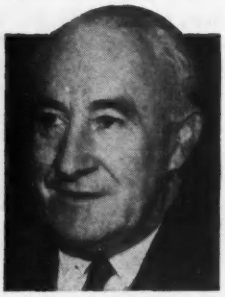
Dr R. H. Golde

Mr M. Waters



Mr F. D. Pratt

Mr L. J. Garibaldi



Mr L. Rumley

Mr A. G. Wray

Generating Engineers' Department, responsible for mechanical design, remaining there until 1946 when he became engineer-in-charge of the Turbine DO. In 1946 he was appointed executive assistant to Mr P. D. Morris, chief turbine engineer; in 1957, personal assistant to the late Mr K. R. Hopkirk, then chief mechanical enginer; and, in 1959, to the post from which he has just retired.

As we briefly noted last week, **Mr L. J. Garibaldi** has been appointed manager, Steam and Gas Turbine Division of the English Electric Co. Ltd., following the retirement on 1 Jan. of **Mr A. Friswell,** M.I.MECH.E., who has been general manager of the Steam Turbine Division since 1949. Mr Garibaldi, who has been contracts manager, Steam Turbine Division at Rugby, since 1955, will be responsible to the general manager, Rugby and Whetstone, for all commercial activities connected with turbines and for the co-ordination of policy in engineering, sales and contracts. He joined the company in 1938 as contracts engineer at Stafford. While there he was responsible for initial development contracts for anti-magnetic minesweeper equipment and, from 1940 to 1944, was in charge of the company's contracts for armoured fighting vehicles and searchlights. He concentrated on steam turbine contracts in 1944-45 and has continued in that Division. In 1949, Mr Garibaldi was appointed senior contracts engineer for steam and diesel plants and in 1950 he became chief contracts engineer, Steam Turbine Division. He has been responsible for contracts engineering of all steam turbo-alternator sets, including the present 350 MW and 375 MW units for Drakelow and Blyth "B," as well as the turbine house for the Hinckley Point nuclear power station.

Mr Leslie Rumley has been elected president of the British Industrial Truck Association for 1961. Mr Rumley is

The New Year Honours List—

MANY names well known in the electrical industry are included in the New Year Honours List announced last week-end. First to be noted is that of **Sir Alexander Fleck,** K.B.E., chairman of the Advisory Council on Research and Development, Ministry of Power, and of the Nuclear Safety Advisory Committee, who becomes a baron. A baronetcy is awarded to **Sir James Bowman,** K.B.E., J.P., chairman of the National Coal Board since 1956.

Among those to whom a Knighthood has been awarded are: **Mr G. C. Beadle,** C.B.E., director, television broadcasting, BBC; **Dr Cecil Dannatt,** O.B.E., M.C., D.SC., M.I.E.E., M.I.MECH.E., A.AM.I.E.E., who became vice-chairman Associated Electrical Industries Ltd., with the special responsibility of co-ordinating both commercial and technical policy, last April (previously he was managing director of AEI (Manchester) Ltd.); **Mr G. G. Honeyman,** C.B.E., Q.C., J.P., "for services to industrial arbitration"—he was chairman of the five-man committee which recently recommended an extension of the interval between statutory inspections of power station boilers; **Mr A. R. Lewis,** chairman of Decca Navigator Co. and Decca Radar Ltd.; and **Prof A. C. B. Lovell,** O.B.E., Professor of Astronomy, University of Manchester, and director of the Jodrell Bank experimental station.

C.B.E.

Those who are made Commanders of the Order of the British Empire include: **Mr J. H. Arkell,** director of administration, BBC; **Mr W. T. Gemmell,** B.SC.(ENG.), A.C.G.I., M.I.MECH.E., M.I.E.E., director, Midland Region, GPO, who joined the Post Office Engineering Dept. as an assistant engineer in 1925; **Mr J. R. Pheazey,** M.I.MECH.E., M.I.PROD.E., F.W.M.A., vice-chairman and joint general manager, Standard Telephones and Cables Ltd. (with whom he completed 50 years' service on 1 Jan.), who became associated with the old Western Electric Co. in London in 1911, and from 1928 to 1932 was in Japan assisting in the rapid expansion of telecommunications there; **Mr J. B. Scott,** ASSOCIATE I.E.E., sales director of Crompton Parkinson Ltd., who is well known for his activities in developing business relations with Russia (in which he has been exceptionally successful); **Mr E. J. Vaughan,** deputy chief scientific officer, Admiralty; **Mr G. E. Watts,** principal of Brighton Technical College; and **Mr E. J. Young,** managing director, English Electric Valve Co.

O.B.E.

Recipients of the O.B.E. include: **Mr H. W. Baker,** M.I.E.E., superintendent engineer, television, London studios, BBC; **Mr W. N. C. Clinch,** M.I.E.E., who has been Divisional Controller, Eastern Division of the CEGB since its formation (prior to 1948 he was general manager of the Northmet Power Co. for five years); **Mr S. J. Emerson,** M.ENG., M.I.E.E., who has been HM Senior Electrical Inspector of Factories, Ministry of Labour, since October, 1955, succeeding Mr F. H. Mann in that position; **Mr F. W. J. Gale,** M.B.E., managing director, S. G. Brown Ltd.; **Mr S. J. Giffen,** senior assistant communications controller, Northern Ireland, GPO; **Mr W. R. Harvey,** manager, Marine Dept., Babcock and Wilcox Ltd.; and **Mr G. D. Ireland,** T.D., chief engineer, Windscale and Calder works, UKAEA.

M.B.E.

Those who are awarded the M.B.E. include: **Mr F. Baker,** assistant works manager, A. Reyrolle and Co. Ltd.; **Mr R. E. C. Brown,** A.M.I.E.E., assistant chief engineer, Telephone Apparatus Dept., Associated Electrical Industries Ltd.; **Mr R. B. Dickinson,** executive engineer, GPO; **Mr J. C. Gale,** director and sales manager, Petters Ltd.; **Mr F. J. G. Haines,** engineer-in-charge (sound), Cardiff, BBC; **Mr E. V. Hardaker,** M.C., B.SC., M.I.E.E., who has been Divisional electrical engineer, Midlands Division, CEGB, since February, 1959; **Mr J. G. Heaps,** chief of test and inspection, Ferranti Ltd., Wythenshawe; **Mr F. E. Huckfield,** assistant engineer, telephone manager's office, Gloucester; **Mr J. T. Jackson,** group works engineer, Joseph Lucas Ltd., Birmingham; **Mr J. F. Lucas,** principal station radio officer, Govern-

sales director of Conveyancer Fork Trucks, Electro-Hydraulics and Conveyancer-Scott Electric Vehicles.

Four new engineering appointments are announced by Marconi Instruments Ltd., of St. Albans. **Mr A. G. Wray,** M.A.(CANTAB.), A.M.BRIT.I.R.E., becomes deputy chief engineer; **Dr R. L. Gilbert,** PH.D., M.A.(CANTAB.), advanced product engineering manager, and **Mr A. Haviland** and **Mr D. R. Willis,** A.M.BRIT.I.R.E., proprietary engineering managers, responsible for the design and development of groups of products. For the past four years Mr Wray has been chief of the company's Advanced Development Group, responsible for the design and development of multi-channel microwave test equipment and nuclear power instrumentation. He joined the company in 1944 and was appointed company physicist in 1952. Dr Gilbert joined Marconi Instruments' Engineering Department in 1958, following three years as a geophysicist in the Dominion Observatory, Ottawa. He has been mainly concerned with the company's instrumentation for Hinkley Point nuclear power station. In his new post, he will be responsible for nucleonics, temperature scanning, and X-ray image brightening equipment. Mr Haviland has been with the company since its formation. For some time he worked in the Production Department and, in 1943, he was made chief of the Development Test Section. Later he took charge of one of the company's engineering groups handling Government contracts and certain proprietary instruments. Mr Willis has served 21 years in the organisation. He gained considerable experience of production methods during his service with calibration and test sections. During the war he was transferred to Development Department, for special duties concerned with shell velocity measurement. Later, he was made responsible for the engineering and production of radar test equipment. In 1952, he was seconded to the company's USA office for engineering duties. On his return, 18 months later, he took charge of an engineering group responsible for those electronic measuring instruments intended for large-scale production.

Mr E. G. T. Charleston has been appointed sales representative for the Westrex Co. Ltd. covering the south of England.

Mr R. E. J. Putman, A.M.I.MECH.E., has now rejoined James Gordon and Co. Ltd. as chief engineer, after having spent several years in England and Canada engaged on the application and development of electronic control equipment and systems for power stations, sugar factories, oil fields, etc.

Mr A. P. Wilson, a senior technician in the radio section of the Department of Electrical Engineering, King's College, Newcastle upon Tyne, has retired. He has received a presentation from students and members of the department.

MK Electric Ltd. have appointed **Mr G. S. Phillips** as area sales representative for Glasgow and West of Scotland. He succeeds **Mr R. McNeill** who resigned his position in November.

awards in the Electrical Industry

ment communications headquarters; **Mr E. W. Raby,** F.S.A.A., F.I.M.T.A., lately deputy chief accountant of the Yorkshire Electricity Board; **Mr W. L. Roe,** chief metallurgist with Aiton and Co. Ltd.; **Mr F. Smedley,** district engineer, Bathgate district, South of Scotland Electricity Board; **Mr C. J. Syvret,** lately engineer-manager, States of Jersey Telephone Dept.; and **Mr R. G. Taylor,** general manager, C and N (Electrical) Ltd.

B.E.M.

The lengthy list of those to whom the B.E.M. has been awarded includes: **Mr J. Carter,** assistant foreman, AEI (Manchester) Ltd., at Eccles; **Mr W. Cullen,** chargehand fitter, Barton power station, Manchester; **Mr E. J. Easter,** lately technical officer, Engineering Depot, GPO, King's Lynn; **Mr R. Goodwin,** foreman, Newton Brothers (Derby) Ltd.; **Mr C. E. Hutcheson,** chargehand electrical fitter, Ministry of Works; **Mr W. H. Johnson,** foreman turbine driver, Walsall power station; **Mr W. S. Kirkbright,** foreman, Southall sub-area Construction Dept., Southern Electricity Board; **Mr T. C. H. Miles,** fitter, Elliott Bros. (London) Ltd.; **Mr A. Miller,** leading stoker, Grimsby power station; **Mr A. Mills,** chargehand, Mid-Sussex sub-area, South Eastern Electricity Board; and **Mr L. R. Sparks,** technical officer, PO Research Station, Dollis Hill.

OVERSEAS

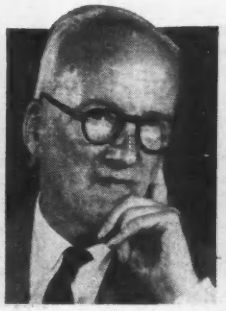
In the various overseas lists we note the awards of the C.B.E. to **Mr R. H. Jones,** M.I.E.E., chief electrical engineer, Crown Agents for Oversea Governments and Administrations; **Mr M. W. Richardson,** Assistant Postmaster-General (services), East African Posts and Telecommunications; **Mr C. W. Goodman,** chairman and managing director of the English Electric Co. of Australasia Pty. Ltd.; and **Mr T. A. Housley,** general manager, Overseas Telecommunications Commission (Australia).

The O.B.E. is awarded to **Mr E. V. Andlaw,** M.B.E., M.I.E.E., electrical engineer to the Gibraltar City Council, and the M.B.E. to **Mr J. W. Morison,** M.I.E.E., who was general manager of the Electricity Authority of Cyprus until recently when the organisation was transferred to the new independent republic—he has since returned to this country and is again with Preece, Cardew and Rider. Another recipient of the M.B.E. is **Mr J. W. Murray,** chief engineer of the Nigerian Broadcasting Commission.

Dr C. Dannatt (Kt)

Mr J. R. Pheazey (C.B.E.)

Mr J. B. Scott (C.B.E.)



Mr W. N. C. Clinch (O.B.E.)

Mr E. V. Hardaker (M.B.E.)

Mr R. Lewis Stubbs, director of the Zinc Development Association, has been appointed director-general of the Lead Development Association and the Zinc Development Association. Mr Stubbs will be responsible for the overall direction and expansion of the work of both organisations, and will represent them at international meetings. Each Association will continue to function separately and general managers will be appointed for both in the new year.

Mr D. W. Payn, T.D., F.C.C.S., has resigned as general manager and secretary to the Lead Development Association to take up an appointment as secretary designate to the London Master Builders' Association.

Mr J. H. Russell, managing director of the Ecclesfield steel works branch of Hall and Pickles, retired on 1 Jan. because of ill health. He has been succeeded by **Mr F. E. Robbins** and **Mr A. M. C. Murphy** as joint managing directors. **Mr John L. Lightfoot** has been appointed secretary to the company. Both he and Mr Russell will retain their directorships.

Mr T. L. Mackie, sales director of Drysdale and Co. Ltd., retired on 31 Dec., but his services will continue to be available to the company in a consultative capacity.

Councillor N. Hogg has been appointed a part-time member of the North of Scotland Hydro-electric Board in place of **Mr J. Jardine,** J.P., who is retiring (*ESH, page 171).

Mr Alan Potter has been promoted to general sales manager of Lansing Bagnall Ltd., **Mr E. H. Wheeler** becomes export sales manager and **Mr C. A. Barr,** manager of the company's technical services division. Mr Potter joined the company in 1956 as personal assistant to **Mr J. R. Sharp,** joint managing director. Since March, 1959, he has been overseas manager. Mr Wheeler joined the home sales office staff in November, 1950, later becoming assistant to the home sales manager. He was appointed export office manager in 1957 and then, in June, 1960, deputy overseas manager. The overseas department has now been renamed export department. Mr Barr joined Lansing Bagnall as a designer in 1950. In 1955 he became chief draughtsman and later transferred to the sales side, working on special technical aspects. Early in 1959 he was appointed overseas liaison engineer.

Mr R. Clarke, O.B.E., M.I.MAR.E., marine sales manager, has resigned from the board of Laurence Scott and Electromotors Ltd. for health reasons, after 48 years' service with the company. **Mr J. B. Wormall,** M.I.E.E., formerly industrial sales director, is now sales director for all the company's products. **Mr J. Calif** has become marine sales manager, and is succeeded by **Mr B. Kidd** as chief estimator of the marine department.

Mr T. S. Nicol is retiring from the position of secretary of the North East Coast Institution of Engineers and Shipbuilders. He became connected with the organisation 48 years ago and has been secretary since 1939.

Mr A. C. Wood-Parker, B.A., C.A., has been appointed a director of the Harland Engineering Co. Ltd.

Vice-Admiral Sir Norman Dalton, K.C.B., O.B.E., has taken up an appointment as technical consultant to J. Stone (Holdings) Ltd., and has joined the board of Epsylon Industries Ltd., electronic engineers. Both companies are members of the Stone-Platt Industries group.

Mr R. H. Thornicroft has been appointed manager, Traffic Department, AEI (Rugby) Ltd. He succeeds **Mr G. O. Pritchard** who relinquished the position on 31 Dec., but will remain, for a time, in the service of the company in a consultative capacity.

In the Electrical Appliance Division of Charles Colston Ltd., **Mr R. S. Monk** has been appointed manager of the southern branch. In the northern branch **Mr N. L. Brooks** has been promoted from area manager to electricity board liaison manager of the Yorkshire and North Eastern Boards and is succeeded as area manager by **Mr R. R. Lane.** In the Scottish branch **Mr L. G. Dickson** is promoted to electricity board liaison manager of the South and North of Scotland Boards; **Mr W. Wilson** becomes area manager, South Scotland district, and **Mr W. J. R. Trapp,** area manager, North Scotland district.

Deputy chairman of the Southern Electricity Board, **Mr S. M. Rix,** F.C.I.S., A.C.A., has been elected president of the Chartered Institute of Secretaries, taking office from 1 Jan., 1961. He succeeds **Mr Ernest Long,** F.C.I.S., F.S.A.A., F.I.M.T.A., a member of the CEGB.

With the increasing use of magnetic components in electronics, the activities of the Component Division of Mullard Ltd. has been sub-divided under its divisional head, **Mr A. F. T. Marner,** into four commercial product groups. These groups and their managers are: Permanent magnets, **Mr B. C. Foreman;** Ferrites, **Mr W. A. Everden;** Computers, **Mr K. R. Patrick;** and Radio and Television, **Mr W. K. Bailiff.** Each product group will provide its own technical service, co-ordinated by **Mr A. J. Tyrrell,** who retains overall responsibility for the technical services of the division.

Mr F. H. Dale, ASSOC.(BRIT.)I.R.E., has been appointed assistant manager, Military Radar Sales Department, AEI Electronic Apparatus Division.

Mr W. F. North has relinquished the post of secretary of Submarine Cables Ltd., and is succeeded in that position by **Mr A. G. Fuller,** F.C.I.S.

A presentation of a silver cigarette box from the directors of Submarine Cables Ltd. was recently made to **Dr E. W. Smith,** PH.D., B.SC., M.I.E.E., who retired at the end of September last. The presentation was made at the AEI Woolwich factory by Dr J. N. Aldington.

OBITUARY

Mr E. C. Linay, M.I.E.E., manager of the Sleaford district of the East Midlands Electricity Board since 1948, died on 30 Dec., aged 65 (*ESH, page 115). Earlier he had been chief engineer and manager of the Sleaford UDC Electricity Department for 14 years following experience at King's Lynn, Worksop and Chesterfield.

Mr A. J. W. Cunningham, managing director of Copes Regulators Ltd., died on 24 Dec.

Mr H. T. Pledge, C.B.E., Keeper of the Science Library at the Science Museum, South Kensington, since 1945, died on 28 Dec. aged 57.

Mr W. J. Goddard, technical sales engineer with the Ipswich office of the English Electric Co. Ltd., died on 21 Dec.

Retiring as director and general manager of the Witton works of GEC, Mr J. J. Gracie was presented with Persian carpet and Georgian silver by his colleagues and friends throughout the company. Mr Arnold Lindley, who assumed the chairmanship of the company on 1 Jan., made the presentation. Our picture shows, left to right, Mr R. N Millard, managing director of the engineering group Mr Lindley, Mr Gracie, and Mr T. H. Kelsey who succeeds Mr Gracie as general manager at Witton

Supergrid crosses the River Thames

TOWER AND CONDUCTOR ERECTION DETAILS

One feature of the 615 ft high towers for the supergrid crossing of the River Thames is provision of a maintenance platform at the 375 ft level. This is shown on the left. A staircase leads up to it, built around a central column. At the top of the tower, above the conductor cross-arms, is a lifting cross-arm

STRINGING operations will shortly be carried out on the 275 kV supergrid crossing of the River Thames between West Thurrock and Northfleet, the main contractors being BICC. The two 615 ft high crossing suspension towers are already in position. Designed by Blaw Knox, they have 100 ft square bases, and top cross-arms 74 ft long. Each tower is built up from 21 main leg sections between 25 ft and 31 ft long.

At every 125 ft in height (every other panel) the slope of the leg members changes. This gives a good appearance to the tower and fits in well with provision of access catwalks to aircraft obstruction lights sited at these levels. At the 375 ft level a "half-way house" maintenance platform is provided which will carry an overhead track and trolley plus winching equipment for lifting spare insulators. At the top of the tower there is further maintenance lifting gear, this being supported by a special cross-arm located above the topmost conductor cross-arms at 31 ft 3 in. intervals.

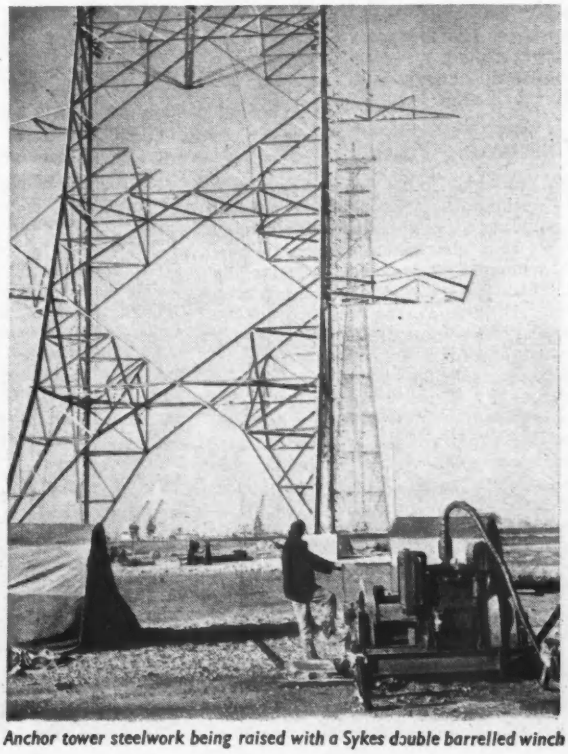
A 15 ft square central column extends upwards from the ground to the 375 ft maintenance platform and around this is built a stairway.

Insulator units by Bullers hang in universal bearings, and the insulator assemblies will have jacking equipment to allow the insulator strings to be removed for servicing and inspection. Each suspension assembly consists of six insulator strings in parallel, while tension sets on the anchor towers have eight parallel strings. All the insulator assemblies incorporate lever balancing between strings and are designed for equal load-sharing if one string should fail. There are 20 porcelain insulators in each string.

In erecting the towers, BICC have worked to an accuracy of ¼ in. over the total span between anchor towers of 7,700 ft. In raising the sections of the towers into position, Sykes winches were used and further winches of this make are provided as an auxiliary on each tower, powered by Ruston engines. A feature of the winches is provision of a special safety brake to take account of any chance that the winch operator might suddenly be incapacitated.

Conductors for the crossing are to be 91/108 strand steel-cored aluminium, matching in capacity the twin conductors of each incoming line bundle. Overall diameter is 2·26 in. and the calculated ultimate tensile strength is 290,000 lb. Maximum working tension is 97,200 lb. A central over-running earth wire will be used for the crossing.

To string the conductors, a fixed track rope is first laid in the river together with a haulage rope. Trolleys carrying the haulage rope run on the track rope. The ends of the ropes pass over wheels at the tops of the towers. The river will be closed to traffic. Each conductor will then be pulled over, with v.h.f. radio control for the operation. Conductor drums will be sited on the north bank, winches on the south. It is a condition of the contract that no conductor shall touch land or water during erection. When conductors reach the anchor tower, they will be tensioned and released from the suspension trolleys, and insulators inserted.



Anchor tower steelwork being raised with a Sykes double barrelled winch

PROBLEMS AND PRACTICE

We welcome contributions to this feature; those published will be paid for at our standard rates. There must be many problems encountered in day-to-day electrical work, or useful ideas or tools devised to make it easier; all make instructive reading.

Air-pressure Alarm

A LOW-PRESSURE warning was required by a section of a factory which depended on the supply of compressed air for its operation. A simple red lamp indicator operated by an air-pressure switch was considered inadequate since failure of the lamp filament would render it inoperative without giving prior warning. The problem was solved by wiring a 150 W b.c. lamp in series with a 15 W lamp, both rated for the supply voltage. The former was placed behind a red glass and the latter behind a blue glass, the air-pressure switch being connected across the 15 W lamp to short it and apply the full voltage to the 150 W lamp when pressure failed.

Normally the resistance of the smaller lamp was such that the larger one hardly glowed, though the small one was nearly at full brilliance. The blue lamp showing, therefore, indicated normal air supply, the red—much brighter—supply failure and both lamps out, a filament failure in one or other of the lamps.

The circuit can be applied to a variety of purposes, the second lamp always giving indication that the circuit is energised. The lowered voltage on both lamps, too, ensures longer life than the normal 1,000 hr for which they are designed.—*Centri.*

Fluctuating Volts

ELO'S experience (22 Dec., page 967) recalls a somewhat similar incident I encountered as a mains engineer many years ago. The householders in a particular road sent in complaints of wildly fluctuating voltages during the evenings, but each time an engineer went up by day with a voltmeter, everything seemed to be in order. At last I investigated the complaint by calling on them at night-time. Surely enough, the lights kept changing in brightness, sometimes well above normal and at others appearing quite dim. Moreover, the changes were quite sudden but at completely irregular intervals. At the last three houses in the road, close to the entrance—it was a cul-de-sac—everything appeared normal. I also ascertained that the disturbed houses were fairly equally distributed over the three phases, so it was not a phase fault.

I cannot remember what gave me the clue, but the next morning I had the road opened up and the straight-through joint on the cable opened for examination. Sure enough, there was a dry joint on the neutral which was virtually open-circuited. With no neutral return to the transformer, the voltage at each house would, therefore, change as the total load on the three phases varied when householders switched on their lights and domestic appliances. Only when the load was evenly distributed would the voltage be normal. The reason it was not disclosed by a day-time check with a voltmeter was that the only loads were the meter potential coils which roughly balanced out. A much abashed jointer remade his joints and all was well.—*Ion.*

Remote Control Mainswitch

ON many occasions lights were left on after a church hall had been closed for the night, sometimes resulting in the calling-up of the minister by the police. The offending lights were usually in toilets and small rooms out of sight of the main entrance door but the main-switch was situated in the basement. To move the latter to a more convenient position close to the door would have been an expensive matter involving the running of long lengths of substantial cable, but by connecting a 15 A single-phase contactor in series with the main-switch and wiring the coil to a 5 A tumbler switch adjacent to the entrance door with 1/0·044 cable it was possible for the last person to leave the hall to cut off the main supply without having to go down to the basement. A notice by the switch stated its purpose and that it must be switched off before closing the hall.—*F. R. Ralph.*

(A practical solution to the problem which, however, has its dangers. A mischievous person or one with more sinister intent can plunge the hall into darkness with ease. Where such devices are installed, a more natural precaution is to site the switch handy to the door, but in a position only known to those authorised to use it.)

Weird Fatality

FORTUNATELY, it falls to few of us to experience an electrical incident involving death and in many years I can only recall one which was, however, sufficiently weird to justify description here and so long ago that no painful memories are likely to be aroused.

The victim was an old lady who was lying in her bed listening to the radio—the bed was a wooden one on an upper floor—when she turned and moved the standard lamp on the side table with one hand and was instantly electrocuted. Impossible you say? So did we when we heard, but the old lady was irrefutable evidence and we had to investigate. The only marks which were to be found were small burns on her hands and one on the bridge of her nose. From these we were able to reconstruct the incident and this is what we found.

The receiver was a tight-coupled crystal set and earphones (that will tell you how long ago it was), the latter having rubber earpieces and metal headbands. There was a fault in the earpieces which, in effect, earthed the headbands. There was also a fault in the handlamp, which made the metalwork alive. Even so, all would have been well since she had a marvellous head of hair but, unfortunately, she was wearing steel rim spectacles which were in contact with the headband. The fatal current had taken a path from the faulty handlamp through her body and to the spectacles via the bridge of the nose and thence via the headbands, earphones and crystal set to the receiver earth. As my assistant remarked when we had unravelled the mystery, it was a ten million to one chance.—*C. Jenkins.*

Rectifier Ripple

A NEW 6 kW 440 V three-phase 50 c/s a.c. rectifier with a 80/240 V d.c. output for research purposes was reported as giving excessive ripple on the d.c. side. A ripple content of 4% had been agreed upon and a smaller rectifier to the same specification was in use without causing complaint. The unit was a cubical type with input and output switches, tapping switch, fuses and meter on the front. No oscilloscope being available the only thing was to make a physical point-to-point check. Fuses were tested and found to be intact. The rotary tapping switch, too, was in order. This left the three-pole main switch which was of a type selected to match the rotary voltage tapping switch, that is, a rotary switch with spring-loaded contacts. A voltage check at this point disclosed an open circuit on one phase and, on dismantling the switch, a spring behind one contact was found to have failed. When this had been replaced and the switch reassembled and connected, the rectifier was again put on load and, to everyone's relief, the ripple disappeared. No further complaints from this unit were subsequently received.—*R.F.*

C. A. PARSONS & CO.

Progress in Manufacture—1960

DESPITE the alarms and excursions, both political and economic, of the past year, C. A. Parsons' record of deliveries and new orders is again a healthy one. With major turbo-generator units as the main product, of which nearly 1¼ million kW have been commissioned during the year at home and abroad, turbines, turbo-blowers, transformers and the associated auxiliaries, the company has reason to be pleased with, though not complacent about, its year's endeavours.

Turbo-generators

Taking, first, turbo-generator units, among the larger sets commissioned in the UK are two of 100 MW capacity at Aberthaw and five of 120 MW capacity at Kincardine, Skelton Grange "B", Drakelow "B" (two) and Rugeley. Incidentally, the year was signalised by the opening of Kincardine by HM the Queen, where three Parsons 120 MW sets are now commissioned.

Among the exported units are the first of two 300 MW cross-compound machines for the Lakeview station of the Hydro-Electric Power Commission of Ontario, Canada, and the last of four 200 MW machines for the Richard L. Hearn station at Toronto. This station, with a total installed capacity of 1,200 MW, is now the largest station in the world with all sets made by one manufacturer. Four other sets, from 66 MW to 10 MW, have also been commissioned in Canada, 60 MW, 30 MW and 15 MW sets in Australia, 30 MW and 10 MW sets in Nigeria, 25 MW sets in Mexico, and 20 MW and 15 MW sets in Trinidad and Jamaica.

In connection with the Dungeness nuclear power station project, due for completion in 1964, the company is to be responsible for the four 142·5 MW main turbines which will be constructed at the Heaton works.

Transformers

The company will also be responsible for the main and auxiliary transformers at Dungeness, comprising four 165 MVA, 13·8/295 kV generator transformers, two 22·5 MVA, 275/7·1 kV station transformers, four 6 MVA 13·8/6·9 kV unit transformers and a number of smaller units totalling, in all, 747 MVA.

Other home orders include a 75 MVA, 132/66 kV transformer for Dunston, two 60 MVA, 132/11 kV units for Peterborough and two 45 MVA, 132/11 kV units to supply an oil refinery in the south of England, all for the the CEGB, while a South Wales steelworks has also placed an order for eight 15 MVA, 33/11·5 kV transformers.

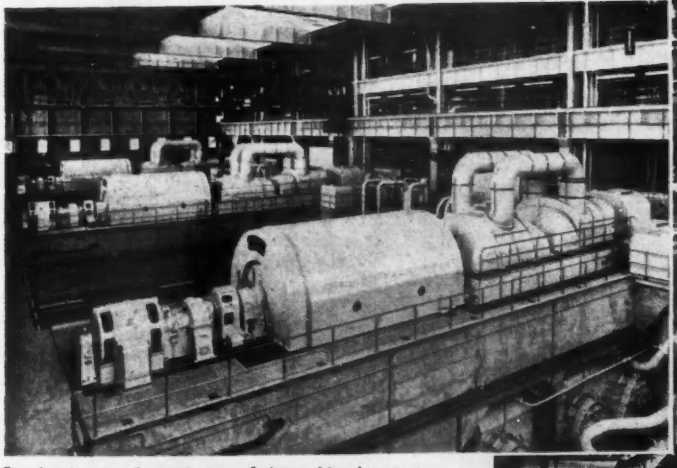


Fig. 1 (above). General view of the turbine house at Kincardine, Scotland, showing the three 120 MW turbo-generators of Parsons design and manufacture. This station was opened by HM the Queen last October

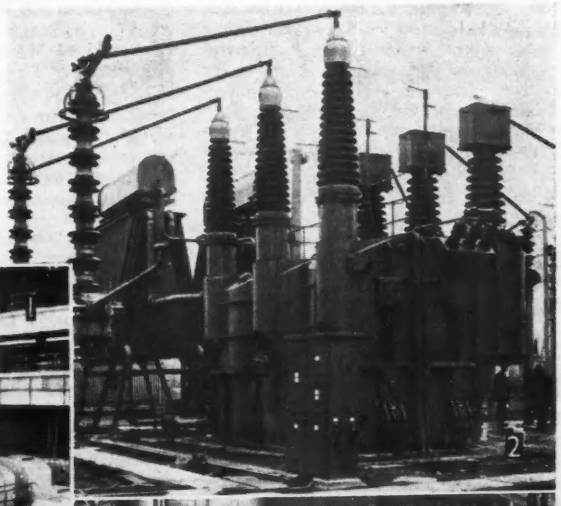


Fig. 2 (top right). One of two 180 MVA 132/275 kV Parsons auto-transformers on site at Keadby power station, Lincolnshire

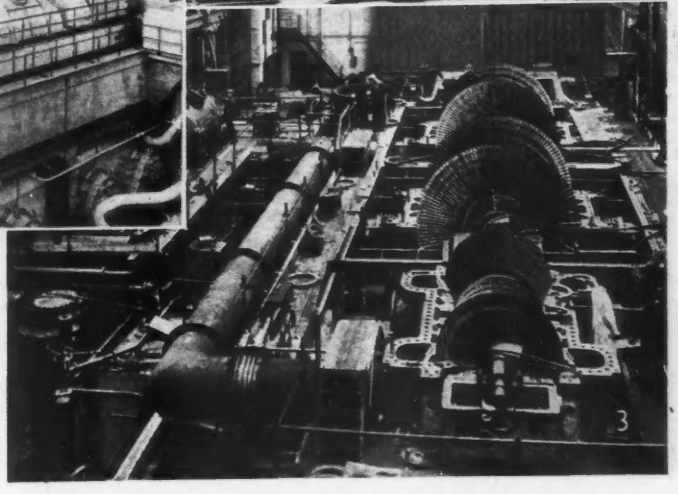


Fig. 3 (bottom right). A view of the turbine blading, 300 MW cross-compound Parsons turbo-generator for Lakeview power station, Canada, whilst under construction at the Heaton works

new products and appliances

Water-heater switches

A NEW range of 20 amp double-pole water-heater switches is announced. Supplied in brown or white, with or without neon pilot lights, the switches are for surface or flush installation. Covers are square with rounded edges and all models have sunken red nylon dollies marked "on" and "off." These switches have silver contacts.

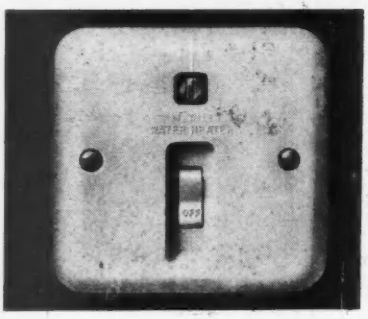
Prices are as follows:

	s	d
Flush/Brown:		
No. 2100	6	4
No. 2105 (pilot light)	11	4
Flush/Ivory:		
No. 2100V	6	8
No. 2105 (pilot light)	11	8
Surface/Brown:		
No. 2150	5	4
No. 2155 (pilot light)	10	4
Surface/White:		
No. 2150V	6	0
No. 2155V (pilot light)	11	0

Pattresses for surface types sell at 1s brown and 1s 4d white. The words "water heater" will be marked on all models at 4d extra to list price. *Nettle Accessories Ltd., Warren St, Stockport, Cheshire.*

Quick-change display colours

A COMMON method of tinting display spotlights is by employing coloured reflectors rather than direct filters. A modification of this system is introduced by Courtney, Pope. Their "Colorite" coloured-glass shades fit directly over normal 48 W 12 V spot-lamps, tinting the reflected light whilst allowing a certain amount of direct white light from the bulb. This system obviates the need for a stock of coloured reflectors as in the method outlined above. The shades are available in six colours, in packs of six and in any choice of the colour range. The coiled fixing spring, which secures the shades, is supplied with the pack.



Nettle's new water-heater switch with neon pilot light and red nylon dolly

TRADE PUBLICATIONS

METOX.—13-page brochure describing a new range of miniature oxide resistors, giving performance data and introductory article on "Total Excursion"—claimed to be a new concept in the manufacture, specification and purchasing of resistors. Welwyn Electric Ltd., Bedlington, Northumberland.

EEZION.—Pamphlet describing ground-level on/off loading transporters, including cable-drum and transformer carrier, vehicle transporter, mobile showroom, tilting platform and articulated types. Ibbett Engineering Co., Stanley Wks, Ampthill Rd, Kempston, Hardwick, Bedford.

EDISWAN-MAZDA.—New semiconductor news bulletin, January, 1961, describing new silicon NPN diffused junction-type power transistors; and six new pages to add to loose-leaf catalogue covering the new range, XC703(2), XC713(2) and DC723(2); nine-page brochure of abridged technical data on semiconductors, dated November, 1960. Associated Electrical Industries, Radio and Electronic Components Division, 155 Charing Cross Rd, W.C.2.

I.C.I. TITANIUM.—16-page technical brochure entitled "I.C.I. Titanium—Corrosion Resistance." Describing properties and applications of the metal. Imperial Chemical Industries Ltd., Metals Division, P.O. Box 216, Birmingham 6.

C.A.V.—Leaflet on 24 V a.c. generating set for commercial vehicles. C.A.V. Ltd., Acton, London W.3.

Colours available are red, yellow, green, orange, blue and a "daylight" blue. The packs of six sell at £4 each, carriage paid. *Courtney, Pope (Electrical), Amhurst Park Wks, Tottenham, N.15.*

Jackson prices—cookers up . . .

PRICES of "Jackson" cookers are increased by amounts ranging from £2 to £4. New prices are as follows: Model 391P £30; Model 391C £32; Model 391CT (timer controlled) £37; Model 493 £49, Model 493T (timer controlled) £54. Model 494 has up to now been available only in a time controlled model. An untimed version has been introduced for this year and the two sell at £59 15s and £54 15s, respectively.

. . . 'fridges down

Model 202 refrigerators, 2 cu ft capacity, are reduced in price with effect from 1 Jan. The wall-mounted version and the table-top version with legs were previously priced £38 17s and £37 12s 6d. respectively. They are now priced the same at £29 17s 6d. including purchase tax. *Electrical Division of Radiation, 255 North Circular Rd, Neasden, N.W.10.*

Atlas fluorescent efficiencies up

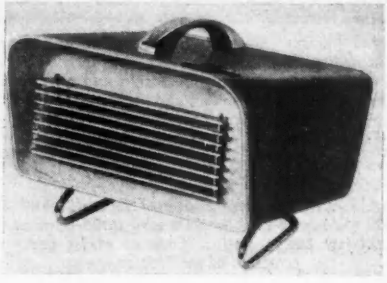
IMPROVED efficiencies in the "De Luxe" warm white fluorescent tubes from 8 ft to 4 ft are announced by Atlas Lighting. The new figures, with the old in brackets, are as follows: At 100 hr, 8 ft 125 W, 5,125 lumens (4,625); 5 ft 80 W, 3,040 lumens (2,800); 4 ft 40 W, 1,640 lumens (1,480). Average through life, 8 ft 125 W, 4,250 lumens (3,750); 5 ft 80 W, 2,480 lumens (2,240); 4 ft 40 W, 1,400 lumens (1,200). Prices remain unchanged. *Atlas Lighting, Thorn Hse, Upper St. Martins La, W.C.2.*

Production-line heat-treatment

AN induction heater unit, the "HSV 300 Universal Hardening Fixture" for production-line heat-treatment of cylindrical components, makes use of a rotating indexing table in conjunction with an induction coil and quenching spray attachment. Six components at a time can be mounted on the indexing table and the machine set-up for automatic operation whereby each component is offered up in turn to undergo a preset treatment cycle. A typical cycle of operations consists of positioning of the induction coil, heating, spray-quenching and withdrawal of the coil; the table then rotates one stop, offering up the next component for the cycle to be repeated. The indexing table can be fed manually or automatically from a conveyor belt. A number of special attachments are available, such as for shaft-hardening. Here the coil is provided with an axial traverse covering 11·8 in. of shaft length. *Delapena and Son Ltd., Tewkesbury Rd, Cheltenham, Glos.*

New tangential fan heater

THE latest introduction in the small, but steadily expanding, field of tangential fan heaters has the characteristic flat bodied styling. Control is by a single switch, giving 1 kW or 2 kW at two fan speeds, or the fan alone for air circulation. Air is drawn into the back of the casing and expelled through a grille in the narrow front face. Styled in up-to-date lines with maroon finish, the heater is mounted on an adjustable tubular metal support. There is a handle on the top of the casing which makes it simple to move about. Dimensions: 9½ in. high by 11 in. wide by 11½ in. deep. Price of this new heater, known as "Record," is £11 17s 6d, tax paid. *S. I. Engel and Co., 25 Kensington Park Rd, W.11.*



"Record," a new tangential fan heater, £11 17s 6d

Headlamp connector

DESIGNED specifically for use with British sealed-beam headlamps, a new connector in the "A-MP" range consists of a tough plastics moulding incorporating three sockets to accommodate "Faston" solderless tags. The tags, manufactured by the same company, are crimped on to the appropriate vehicle supply leads and pushed home into the moulding sockets where they are retained by snap action. Three other sockets in the moulding engage with element contacts projecting from the headlamp body. Connection thus made is claimed to be vibration-proof and to give low contact resistance. The connector being irreversible, the possibility of plugging in headlamp contacts with incorrect polarity is avoided. The device is said to be also suitable for use with other electrical components on vehicles. *Aircraft-Marine Products (Great Britain) Ltd., Amplo Hse, 87-89 Saffron Hill, E.C.1.*

Silicone rubber price cut

THE third of a series of price reductions have been announced by Midland Silicones Ltd. for "Silastomer" series 2452-2455 silicone rubbers. The new price is 28s/lb. These rubbers, until recently still under development, are now classified as regular grades and are available from stock. Among advantages claimed over older established grades are, easier processing, superior surface finish and greatly improved resistance to boiling water and steam. *Midland Silicones Ltd., 68 Knightsbridge, S.W.1.*

Room air conditioner

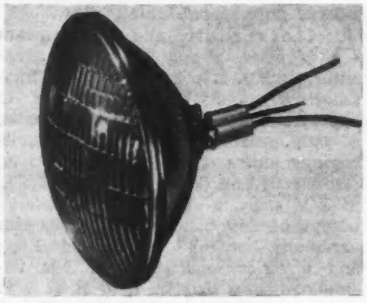
THE "Whispair" room air conditioner was described on this page on 8 Dec. This "packaged" conditioner is, in fact, available in an air-cooled as well as a water-cooled model, the former of which requires an outside air intake. The paragraph also quoted the figure of 1,590 W as the cooling capacity. This refers to the power input of the machine, the cooling capacity being 12,000 B.Th.U's/hr. "Whispair" is produced by *Temperature Ltd., Fulham, S.W.6.*

HMV iron price change

THE HMV standard electric iron is to be increased in price. This iron, Cat. No. IC10, originally selling at £2 12s 6d is now priced £2 15s tax paid. The change will be effective from 1 Feb., 1961. *The Gramophone Co., Hayes, Middx.*

Fire alarm

TO meet the Ministry of Labour's factory requirements in the installation of fire alarms at accessible points, four push-button units with glass covers over the button are now available. Two operate immediately the glass is broken; the other two require depression of the button as well. Each type is available as a make-circuit or a break-circuit pattern. The cast-iron box is painted red and a hammer, attached by a short chain, is provided. *Dewhurst and Partner Ltd., Hounslow, Middx.*



◀ *A-MP connector on sealed-beam headlamp*

Switch price changes

PRICES of Nettle's 13 amp double-pole flush switch sockets are reduced by 3s per dozen. List prices now stand as follows:

Flush/Brown	...	S.F. 1239	69s doz
Flush/White	.....	S.F. 1239V	77s „

Pilot light models sell at an extra 64s doz. *Nettle Accessories Ltd., Warren St, Stockport, Cheshire.*

MULTI-WAY RECORDERS AND CONTROLLERS

TWO new recorders and a process controller measure or regulate several variables. One of the recorders is a multi-point type designed for easy changing of both the number of variables recorded and their scale. For continuous recording a 14-channel pen recorder is available with a high frequency response. In both these recorders the design emphasis has been placed on simple and speedy change of scale, and constitute a low inertia system said to be suitable for recording at up to 5,000 c/s.

Quick variation in the number of channels, their ranges and the compensation for different signal source is possible with Honeywell Controls latest "Universal Elektronik" multi-point recorder. Up to ten variations in the number of channels used are possible, between two and 24 by three simple adjustments. These are: replacing of the print-wheel/indicator dial, changing the range resistor card and, if necessary, altering the input terminal board to match the characteristics of the signal source. The Universal design can be incorporated in new versions of the company's non-control strip-chart recorders.

Another versatile recorder, but one giving a continuous recording is now available from Smiths Industrial Division. This recorder is of Swedish design and has two magnet assemblies each providing seven channels. The signal trace is recorded on sensitised paper by high intensity u.v. light beams reflected from mirror galvanometers. The galvanometer assemblies can be changed

The "Ultragraph" unit is said to give high definition recordings on 6 in. wide paper, requiring no additional processing. Intensity of the trace can be varied to give a fine trace at low speed or a more clearly defined trace at high speeds. The paper speed is continuously variable between 0·1 cm/sec and 0·8 cm/sec and an integral timer gives timing lines across the paper at 0·1 sec and 1·0 sec intervals. A high pressure m.v. lamp with an automatic ignition circuit to eliminate cooling time delays provides the u.v. light. The recorder measures 9½ in. by 11 in. by 19½ in. and weighs 44 lb.

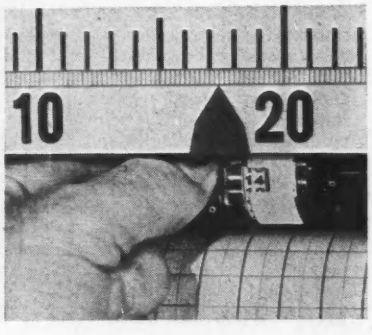
Although not strictly a chart recorder, the Wheelco Series 2000 programme controller uses a round chart and claims to be suitable for controlling almost any variable which can be interpreted by a millivolt signal. The time sequence of the process to be controlled is determined by a plastics cam. As the cam rotates, electronic circuits ensure the required variable control which may be for example, temperature or speed, is applied. The Wheelco controller is marketed by Ad. Auriema Inc.

Honeywell Controls Ltd., Greenford, Middx.

Smiths Industrial Division, Chronos Wks, North Circular Rd, N.W.2.

Ad. Auriema Inc., Europe S.A., 172a rue Brogniez, Brussels 7, Belgium.

▲ *The Wheelco 2000 electronic programme controller incorporates plastics control cams giving variation of the output with time*



By changing the print-out wheel and resistor range card, this Honeywell Universal multi-point recorder is quickly converted for use on a different number of variables ▶

Commercial radiant oven plate

COMMENTING on our report in the issue of 8 Dec. of a radiant hotplate claimed as the "first" for commercial ovens, Backer Electric Co. have pointed out that they have had available heavy duty radiant boiling plates for catering equipment, made against customers' requirements, since 1952. They instance a 5 kW 16 in. by 12 in. plate (£7 17s 4d each in medium quantities) and a 12 in. by 8 in., 2½ kW unit, priced £6 3s 2d. *Backer Electric Co., Rotherham, Yorks.*

H.V. silicon rectifier

RECENTLY introduced is a silicon diode rectifier having a peak inverse voltage rating of 1,500 V at 300 mA and claimed to give stable operation at up to 150°C. Reverse leakage current at the rated voltage is 100 μA at 75°C. To give optimum heat dissipation the unit is designed for stud-mounting on equipment chassis; depending upon polarity required, either cathode- or anode-stud types are available. *International Rectifier Co. (Great Britain) Ltd., Hurst Green, Oxted, Surrey.*

Power supply sub-assemblies

A CONVENIENT and flexible means of power supply for various transistor circuits, is provided by four transistorised sub-assembly units used in appropriate combinations. These consist of two unstabilised power supply units having outputs of up to 1 A and 5 A, respectively, at 0 to 39 V, adjustable in 3 V steps; a stabiliser unit with an output of 250 mA catering for mains variations between −15% and 10%; and a series regulator unit. The unstabilised units may be used alone with circuits where voltage variation is not critical, while to provide stabilised supplies they are used in multiple combination with one or both of the other unit types. *Mullard Equipment Ltd., Mullard Hse, Torrington Pl, W.C.1.*

"Trouble shooting" booklet

INTENDED to highlight common problems met with in electrical fault finding and maintenance, a monthly series of booklets is to be issued by the Pyramid Instrument Corporation. The booklets are claimed to offer readers factual fault-finding methods tested in the field, the first of the series being entitled "Trouble Shooting Motors with a Volt/Ammeter." Booklets are available only through stockists of the "Amprobe" range of test-meters (described in Equipment for Industry, ELECTRICAL TIMES, 20 Oct., 1960). *Pyramid Instrument Corporation, Sales Division, H. J. Baldwin and Co. Ltd., 221 Grand Bldgs, Trafalgar Sq, W.C.2.*

Silicon power transistors

WITH the introduction of three types of silicon n-p-n diffused junction transistors, AEI announce their entry into a new field of manufacture. The transistors are intended for a wide range of industrial applications such as power switching, pulse amplifier circuits and servo amplifiers. Collector/base voltage is 60 V and the three devices have maximum power dissipations of, respectively, 2 W, 7·5 W and 30 W at 100°C. Operating temperature range is −65°C to 175°C. *AEI Radio and Electronic Components Division, 155 Charing Cross Rd, W.C.2.*

INSTRUMENTS FOR SPECIAL TASKS

TO meet the need for level control, vital to many industrial processes, both electrical and mechanical systems are in use. Two new controllers give level indication by conductance and capacitance probe techniques while a third system relies on mechanical interference with a vibrating probe by the material rising to the required level. Turning to instruments, a contact-making voltmeter is now available with the advantages of the electrostatic movement.

Electrostatic voltmeter

Improvements in design, enabling higher torque to weight ratios to be obtained, are used by Nalder Bros. and Thompson Ltd. in a contact-making electrostatic voltmeter which can be used for on-off control or for alarm and indication purposes. Use of an electrostatic movement has the advantage of dispensing with temperature sensitive shunts. It is also said to be free from drift. Since only a relatively low torque is available from the movement, the pointer is only used to operate a set of light contacts. These contacts are connected in the grid circuit of a valve amplifier and this controls the external circuit through plug-in relays. The contact-making instrument is available for voltages from 100 V to 15 kV and the contacts can be adjusted to the required setting externally. Although particularly suitable for laboratory work, the instrument is said to be sufficiently robust for use in power stations and for industrial applications. Typical applications are the testing of high voltage capacitors to a predetermined voltage, and as earth leakage indicators for fully insulated a.c. or d.c. distribution systems.

Frequency measurement

A feature of the transistorised frequency meter now available from Firth Cleveland is the built-in lightweight rechargeable Venner Silver Zinc battery which ensures a compact, portable instrument. The meter has four ranges covering 0·2 kc/s, 2 kc/s, 20 kc/s and 200 kc/s to an accuracy within 2½% at f.s.d. for an input signal between 0·075 and 10 V r.m.s. The battery capacity is sufficient for 20 hours' continuous use and the meter incorporates a self-regulating charging circuit. The meter can also be energised from the mains supply. The meter case, of plastics covered metal, is designed to allow for stacking with other instruments. Alternatively, a panel mounting version is available. The instrument can also be used for tachometric measurements using either a magnetic pick-up coil and toothed wheel, or a photo-transistor head and light source.

Level control

Level control for practically all granular solids and liquids, including corrosives is said to be possible with the Firth Cleveland vibrating probe level detector. A substantial aluminium casting houses a magnet and coil assembly which causes a probe to vibrate.

The probe projects into the material container and when the desired level is reached, the material stops the probe vibrating. This interruption operates a control relay and amplifier. The probe unit operates satisfactorily over the temperature range from −40°C to 200°C and it can be sited up to 300 ft from the amplifier unit. For level detection with conducting liquids, the same company are marketing a conductivity probe unit which is claimed to indicate level to within ± 1/16 in. This detector will operate over the same temperature range as the vibrating probe and, in addition, will withstand pressures up to 500 lb/sq in. The probe and amplifier units are housed in robust aluminium alloy cases and may be mounted 1,000 ft apart.

The new Nalder Bros. contact-making voltmeter.

The third type of level controller is a development of the Thomas Industrial Automation "Leveltron." This system uses only one electrode. In addition to giving continuous indication of level, the Leveltron can now be designed to give high and low level alarms. Flexible electrodes up to 60 ft in length or rigid electrodes up to 6 ft can be used with the system. The stabilised power supply, relays and calibrating equipment are housed in a weatherproof enclosure which may be sited up to 150 ft from the electrode head unit.

Nalder Bros. and Thompson Ltd., Dalston La Wks, E.8.

Firth Cleveland Instruments Ltd., Treforest, Pontypridd, Glam, Wales.

Thomas Industrial Automation Ltd., Station Bldgs, Altrincham, Ches.

News of the Week

Approvals Scheme Extended

—and B.S.I. to add Safety Standard for Appliances

FOUR more types of appliances have become eligible for submission for approval by the British Electrical Approvals Board for Domestic Appliances. They are shavers, toasters, coffee percolators and washboilers. All will be tested for compliance with British Standards, which are to be re-issued as parts of a comprehensive BS 3456: Test and Approval Specification for Domestic Electrical Appliances. BEAB says it is approaching all known manufacturers of the appliances concerned with details of the approvals plan. Those who do not receive information directly may obtain it from the Director, BEAB, 27 Cockspur St, London S.W.1. Applications for inclusion in this group must be received by 31 Jan. if the appliances are to be included when the approved makes are announced simultaneously on 1 May next.

For the first group of appliances tested, fires, kettles, and vacuum cleaners, successful applicants will be authorised at the end of February to use the BEAB mark.

It has been announced that approvals marking of electric blankets is continuing for the time being under the BSI Kitemark scheme. However, plans are being made for transfer to the BEAB scheme.

BSI, in a statement about the new BS 3456, say that this number has been reserved to permit unique association with the BEAB mark. All approvals requirements for domestic electrical appliances will be incorporated as part of the one BS. It will be issued in a number of parts, including Part A, heating and cooking appliances; and Part B, motor-operated appliances. Each part will be divided into sections, the first of which will deal with general requirements applicable to all appliances in the group, while subsequent sections will cover particular requirements for individual types of appliance. All the sections will in due course be drafted in uniform pattern, but for the present some existing standards will be re-issued in their present form bearing the new number. The first will be the standard for electric fires (BS 1670) and that for vacuum cleaners (BS 1645).

PAY RISE IN N. IRELAND

CLERICAL staff of the Electricity Board for Northern Ireland have won their claim for pay parity with electricity staffs in Britain. They have just received backdated increases in pay which, for some, has meant a lump sum of up to £137. Over 400 members of the Board's staff benefit. Made retrospective for nearly a year, the increases represent the new schedule of salaries for the general clerical grade for men and women, with a starting salary of £221 per annum at the age of 15, rising to £637 per annum. The top grade rises to £1,356.

To take full effect from 1 Jan., 1962, agreement has also been reached for the introduction of equal pay for female staff by three annual instalments, starting as from 1 Jan., 1960.

Derritron Group Expands

THREE new companies are joining the Derritron Electronics Group, making a total of ten companies all specialising in non-domestic electronic equipment. The latest additions are Beulah Electronics Ltd., Direct TV Windings Ltd. and Direct TV Replacements Ltd. Mr. A. Rose, who previously headed these companies, will be managing director, under the chairmanship of Mr. V. G. P. Weake, who has been chairman of the Derritron group since its formation.

Other concerns in the group are: BEME Telecommunications Ltd., Chapman Ultrasonics Ltd., Doran Instrument Co. Ltd., Reslosound Ltd., LSB Components Ltd., BEME Research and Development Ltd. and Electronic Vibrators.

FIRST HYDRO SCHEME IN HEBRIDES

THE Outer Hebrides now has its first hydro-electric scheme in operation—the North of Scotland Hydro-Electric Board's Loch Chliostair project was commissioned last week.

The scheme utilises the waters of Loch Chliostair, which lies in the hills behind Amhuinnsuidhe on the northern shore of West Loch Tarbert, about 12 miles from Tarbert, on the Isle of Harris. A dam 40 ft high has been built across the River Eaval at the outlet of the loch and water is led by pipeline to a 1,000 kW generating station situated on the bank of the River Eaval into which the turbine discharges. There are two 500 kW machines operating on a gross head of 400 ft.

East Midlands Record

OVER a third of all new generating plant installed in England and Wales during 1960 was in the East Midlands Division of the CEGB. Commissioning of No. 3 200 MW set at High Marnham and No. 8 120 MW unit at Drakelow last month brought the Division's total capacity to over 4,000 MW. Of this, plant totalling 748 MW (output capacity) was installed in the East Midlands Division during 1960, compared with 1,111 MW elsewhere.

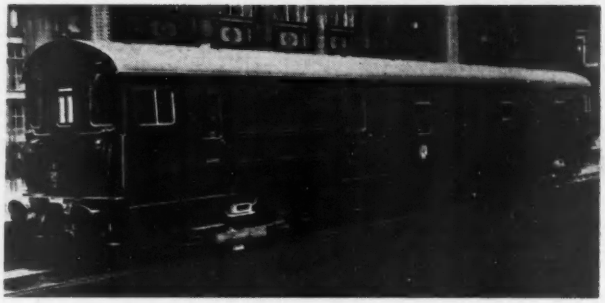
BRUCE PEEBLES-BELMOS MERGER PROPOSED

YET another electrical merger is planned —Bruce Peebles and Co. Ltd. with the Belmos Co. Ltd. Discussions on the matter have been taking place between the directors of both concerns, Mr Sam A. Gaskell, chairman of the £1·1 million Bruce Peebles company, revealed last week when reporting delays in the company's reorganisation plan (see page 34). The Belmos company, which now employs about 1,100 people at its Bellshill, Lanarkshire, factory, was formed in 1919 by Mr Thomas Coughtrie, C.B.E. (now chairman), who is also a director of Bruce Peebles and chairman of Everett Edgcumbe and Co.

Belmos produce mining switchgear and control gear, whereas Bruce Peebles and Co., which was formed in 1908, specialise mainly in heavier equipment and employ nearly 2,000 people at the Edinburgh works.

A young "spark" at work in the living room at EDA's stand at the Schoolboys' Exhibition at Olympia which is open until Saturday. Teams of two boys each race to put the greatest number of plugs for various appliances in the correct positions in two minutes. Then they take home a plan for wiring the rest of the house to complete with the aid of their families and post to EDA by 31 Jan. First correct entry opened will win £5.

Battery powered rail vans successful—Southern Region order more



One of the battery equipped coaches already in use on the cross - Channel service. The luggage compartment is fitted with three pairs of double doors on each side, wide enough to take pallets

EIGHT more rail coaches which may either pull electric trains or propel themselves by battery on unelectrified line are to be installed by Southern Region of British Railways in the next eight months as part of the Kent electrification scheme. With all but two driver's cabs and a guard's compartment given over to luggage space, two vans of this type, unique to Southern Region, have been in use for boat-trains to Dover and Folkestone for 18 months, and have proved highly successful for handling passengers' baggage between ship and train. On arrival at the port, the vans are detached and driven by battery over the unelectrified line to the quayside. DP Battery Co., of Bakewell, Derbyshire, who supplied the batteries for the first two vans, have already received orders to equip the eight new vans.

The vans are powered by an 88 cell 230 Ah DP Kathanode traction battery. When battery power is selected by push-button, the collector shoes are pneumatically held clear of the conductor rail to allow exit from unelectrified sidings. The compressor and exhauster are supplied from the traction battery, or from its charging supply when on the electric line, but the control gear and lighting are supplied from a 70 V source consisting of a generator driven by the same motor as the 200 V generator and another DP Kathanode battery of 30 cells 42 Ah capacity.

Trams will roll again — at museum

THE Tramways Society now has 21 tramcars in its museum at Crich, Derbyshire. Latest arrivals, the last of a consignment of six from Sheffield Corporation, are a 1937 model and a former Bradford tram which Sheffield Corporation bought in 1942 and converted to a "scrubber" for cleaning tracks. Eventually the Society is to spend £2,000 on a length of track so that the trams can run again.

Oldbury reservoir contract awarded

ONLY two months after the CEGB was granted Government permission to build a 550 MW nuclear station at Oldbury, Sir Lindsay Parkinson and Co. have been awarded a £2·2 million contract to construct the water-circulating system. The contract includes construction of a 350 acre reservoir on the river front and site preparation for the atomic reactor. The contract for constructing the power station itself is unlikely to be awarded for several months. The Severn estuary will have the largest concentration of nuclear generating capacity in the world when this project and the Berkeley and Hinkley Point stations are completed.

EAST KENT ELECTRIC TRAINS 18 MONTHS EARLY

ELECTRIC trains began replacing steam and diesel between Dover and Ramsgate on Monday—18 months ahead of schedule. This is part of the second phase of the Kent electrification due for completion in June, 1962, covering London to Ramsgate via Sevenoaks and Dover. Timetables will not be altered until the phase is complete, but British Railways decided that passengers should have some of the advantages of modernisation right away. Although the East Kent section has been completed ahead of schedule, a Railways' spokesman said there was little likelihood of the second phase being finished ahead of time because of the complicated colour-light signalling system to be installed. The first phase, London to Dover via Chatham, has been running since 1958, bringing a spectacular increase in passengers.

Electrification of the Dover-Ramsgate section took 14 months. The work involved laying 45 miles of conductor rail and 21 miles of cable troughing and installing five substations and six paralleling units to control power.

ARC FURNACES ORDERED

GWB Furnaces Ltd., of Dudley, have now won contracts to build four of the six electric arc melting furnaces required for Steel, Peech and Tozer's £10 million electric steelmaking project at Rotherham, Sheffield. GWB received an order for two a year ago, and a similar order was announced last week. Orders for the remaining two furnaces have yet to be placed. The furnaces, of German design, each have a rating of 40 MVA, and a steel capacity of 150 tons. The first is due to begin production in January, 1963, and the last in 1965. This will be the first time that arc melting furnaces are used for bulk steel production; previously the method has only been used for alloy steels. The battery of six will replace 21 open hearth furnaces which are fired by oil or gas.

Company Expansion

LEEDS and Northrup Co., of Philadelphia, recently acquired all the outstanding shares not previously owned by it in Integra, Leeds and Northrup Ltd. The title of the latter concern has now been changed to Leeds and Northrup Ltd. and the board of the company consists of Mr I. M. Stein (president of the parent company) as chairman, with Mr J. J. A. Rogister and Mr J. W. Robinson as joint managing directors. The parent company intends to supply substantial additional capital to the British firm (which makes measuring and controlling instruments and electrical heat treating furnaces) in order that the company shall embark on a programme of development and expansion to take advantage of the widening market in England for its products and services.

POWER FARMING CONFERENCE

THE tenth National Power Farming Conference will be held at Brighton from 7 to 9 Feb. None of the papers to be delivered deal specifically with electrical topics. Sir Patrick Hennessy, chairman of Ford, will open the conference, at which experts will describe developments in agricultural mechanisation under the general heading "power to compete." Admission is free, by ticket obtainable from the organiser at Dorset Hse, Stamford St, S.E.1.

OFFICIAL PUBLICATIONS

BS 3296. Safety requirements for domestic electric hair dryers. 6s.

Sound Absorbing Materials. DSIR publication. HMSO. 3s.

Annual Bulletin of Electric Energy Statistics for Europe. 1959. 7s (see page 8).

SQUEEZE ON EXPORTS

Six move towards common tariff

THE real pinch on British exports to the European Common Market began this week. From 1 Jan. the first step by the Six towards a common external tariff became effective. At the same time, the Six made a further tariff cut of 10% between themselves on industrial goods, bringing the total reduction within the community to 30% since 1957. These trends will gather momentum and the climax will come in 1966, when the Common Market will be fully implemented.

Under the first move towards a common external customs duty every tariff item which is less than 15% above or below the eventual common external tariff is automatically reduced or raised to this level; every item which is outside this range will be reduced or raised by 30% of the difference between it and the eventual common external tariff. (The level of common tariff to be eventually adopted is the average of the various countries' tariffs as at 1 Jan. 1957). The practical effect of this is that Benelux and German external tariffs have been increased, but Italian and French reduced.

For example, Germany hitherto charged no tariff on transformers. The target common external tariff is 17%* on transformers weighing 10 kilogrammes or less and 14%* over 10 kilogrammes. Germany will henceforth charge tariff on transformers, but certain reductions from the new level may be made in Germany's case.

The table shows the approximate levels of tariffs British exporters are likely to have to face in Common Market countries. Competition will be keen because tariffs between the Six are already lower than this in most cases and will finally be eliminated.

	France	Germany	Italy	Benelux
Generators: 10-1,000 kg	16·8	7·5	14·0	8·5
Transformers: Over 10 kg ...	17·3	3·4	20·9	9·0
Washing machines	18·0	10·1	26·2	8·8
Vacuum cleaners ..	19·0	10·1	31·2	13·0
Storage water heaters	22·3	7·8	24·6	16·0
Switches, etc. ...	19·0- 21·3	6·2- 7·1	16·0	10·9- 11·2
Cables, armoured...	19·4	9·6	21·5	9·7- 13·6

*Percentages for various goods are listed in a publication entitled, *Tarif Commun*, obtainable on order from the Stationery Office in French, German, Italian or Dutch (price 25 new French francs). The list will soon be re-issued under the title *Tarif Douanier des Communautés Européennes* (30 French francs), to amend List G items, which are not primarily electrical. In calculating new external tariffs, a new provisional reduction of 20% in the base common external tariff has to be taken into account.

Electric trains back on Eastern line

ELECTRIC trains are running again on the new 25 kV line from Liverpool St. to suburban areas north east of London. Eastern Region of British Railways say 42 of the 52 faulty trains have now been modified, and most of these are back in service. Contractors' engineers are working day and night on the remaining 10 trains, but no date could be given for restoration of full service.

All electric trains were withdrawn from the line in mid-December, due to breakdown of motor insulation and supply rectifiers under transient voltage conditions. Makers of the equipment were GEC.

Warehouse gutted at Nottingham

A FIRE which gutted the Nottingham warehouse of Furse Wholesale Ltd. on 23 Dec. destroyed virtually the whole stock of electrical appliances and contractors' material, but the firm is back in business from adjacent premises this week. Both stock and premises were insured. Damage was estimated at £100.000 at least, Mr Peter Furse, joint managing director, said. Remains of the two-storey warehouse may be demolished and a new building put on the site. The fire, cause of which is unknown, got a hold in the packing room while employees were holding their Christmas party in the offices above. At the height of the blaze, nearby shops and houses were evacuated, but firemen saved surrounding property and nobody was injured.

£3M CONTRACT FOR A.E.I.

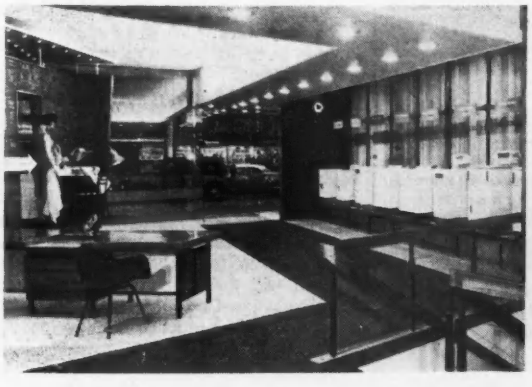
AN order for a 275 MW hydrogen-cooled turbo-generator for the next stage of Vales Point power station, has been placed with Associated Electrical Industries Ltd., by the Electricity Commission for New South Wales. (The first three 200 MW sets for the station are being supplied by English Electric Co.) This larger set, valued at £2 million, is due for commissioning in 1965. AEI have also been awarded a £1 million contract for 13 transformers for the Commission.

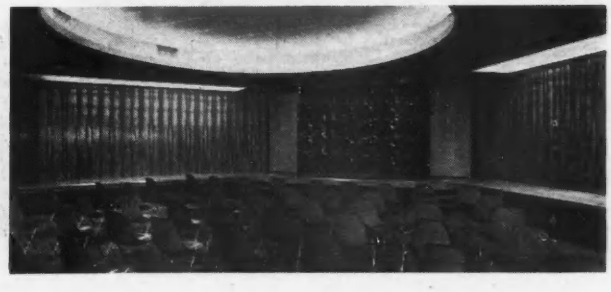
New domestic appliance centre for London

A NEW domestic appliance centre at which the range of AEI-Hotpoint domestic electrical appliances will be demonstrated daily by the company's team under the leadership of Mrs Leslie Keir, home economist and domestic adviser to Hotpoint, was officially opened by Lady Chandos on Monday, 2 Jan., at the junction of Oxford St and John Princes St. Lady Chandos was introduced by Lord Chandos, chairman of AEI.

The new premises, a corner site with ground floor and basement accommodation, is a spacious showroom with a full range of the company's domestic products connected up for demonstration with, in addition, a large and commodious theatre and cinema where full-scale lectures and demonstrations will be organised for housewives, domestic appliance dealers and their staffs.

The centre will also serve as a shop window for foreign buyers for whom a new export drive is being launched by the associated company, AEI-Gala, but this will not be allowed to overshadow the company's home markets which, as Lord Chandos pointed out, are far from being saturated and are only temporarily restrained by the current credit restrictions.





Left is a general view of the interior of the ground floor showroom at the new AEI-Hotpoint home centre in Oxford St, London. Below is the lecture theatre where full-scale demonstrations will be given

Computers in Steelmaking

ANNUAL general meeting of the Iron and Steel Institute is to be held in London on 3 May and 4 May, 1961. There will be technical sessions devoted to the use of computers in the iron and steel industry and to the Brymbo oxygen steelmaking process. At the same time, a joint symposium with the Institute of Metals on structural processes in creep will be held. Sir Charles Goodeve, O.B.E., F.R.S. (Director, British Iron and Steel Research Association), will take office as president of the Institute at the meeting.

Formal business and sessions on computers (which will be under the aegis of the British Conference on Automation and Computation) and oxygen steelmaking will take place at the Institution of Mechanical Engineers, Birdcage Wk, London S.W.1. The joint symposium on creep will be held at the Hoare Memorial Hall, Church Hse, London S.W.1.

Electrical Energy Conversion

THREE lectures on electrical energy conversion are to be given by Professor D. C. White, PH.D., at Queen Mary College, University of London, on 23, 24 and 26 Jan. Dr White is professor of electrical engineering at the Massachusetts Institute of Technology, and the lectures will cover a discussion of the principles of thermoelectric, thermionic and magnetohydrodynamic energy conversion and a review of current research and device developments in these fields. Admission to the lectures is free. They will be held in the College's Hatton lecture theatre, Mile End Rd, E.1. They will begin at 5.30 p.m. on each day.

CONTROL GEAR FOR "CLIMBING" CRANES

THE 32-ton three-motor "climbing" cranes being used in the construction of the new Firth of Forth road bridge—the world's fourth longest suspension bridge—have electrical control gear manufactured by Allen West and Co. Ltd. to the order of John M. Henderson and Co., of Aberdeen. The cranes are for the erection of the steelwork of the bridge's two main towers. As each tower rises on its concrete foundations the climbing structure built round the tower is raised progressively by a hydraulic jacking system. In the final stages the crane will be some 500 ft above the river level, at which heights, gales and heavy mist have to be contended with and the electrical equipment is designed to withstand the conditions.

Contactor-type control gear with master drum controller is used for the hoisting motion, the contactor panel being provided with a strip heater. A 60 h.p. motor gives the crane a hoisting speed of 17 ft/min. The slewing motor develops 7½ h.p. and has overload relays designed to give protection against gales.

The derricking motion is derived from a 30 h.p. motor with control equipment arranged for rotor resistance control.

Final tests on a contactor panel

P.T. on Flashlights

THE Customs and Excise has announced that after 1 Feb. the 25% charge under Group 24 of the Purchase Tax schedule will apply to all hand-held lighting units designed to operate in conjunction with cine or other cameras, whether or not the units are provided with camera platforms and whether or not the latter are drilled to accommodate a camera-fixing screw.

Studio lighting units not designed to be held in the hand are not at present affected by this decision and remain outside the scope of the group.

Staff Cuts in TV and Radio

THE Spennymoor factory of the Ferguson Radio Corporation is to close very shortly, due to falling orders. Some 500 workers have been employed there and it is understood that a number of them have agreed to transfer to the Enfield factory. This decision to close the radio and TV factory will in no way affect the company's intentions to expand other Thorn factories at Spennymoor where lighting equipment and domestic appliances are made. The company state that for some six months trading conditions in the radio and TV business has been deteriorating. In the last two months, normally the peak selling period, sales have declined further. In spite of steady reductions in the factory personnel, stocks of finished products have been increasing. At the Plymouth factory of Bush Radio nearly 150 of the staff will shortly be given notice. (The company employs over 1,900 people at the factory.) Some 900 employees of TV Manufacturing Ltd., of Lowestoft, a subsidiary of Pye Ltd., have just started a four-day week.

Fewer Import Forms

Further simplification of Britain's exchange control came into effect on Monday. A special form to obtain official permission for payments outside the Sterling Area is no longer required up to £2,000, compared with £500 previously. Even for payments over £2,000 a form will not be required if a certified Exchange Control copy of the customs entry is produced to the paying bank.

Right: Barnsley (Eldon St) service centre's display, class A winner of YEB's Christmas window competition

Left: Leeds (Albion St), winner of class B (service centres with a frontage not exceeding 20 ft). Yorkshire EB holds the competition each year. The judges said choice of winners was no easy task

Most Area Boards will raise Tariffs

Most Area Boards will raise their tariffs soon as a result of the CEGB's increases in bulk supply tariffs from 1 April (reported in the ELECTRICAL TIMES last week) and their own higher wage costs. North Eastern EB expects the increase to be of the same order as the CEGB's, which was 3¼% on the normal fixed charge/kW of maximum demand and 2½% on the basic kWh tariff. LEB is considering the amount of increase, and Eastern is reviewing the position. Southern say they will not be lifting charges before April. East Midlands expect their costs to be about £2½ million higher in 1961-2, and MEB £3 million.

Technicians in Industry

EMPLOYERS in the engineering and chemical industries in Gt. Britain forecast that the demand for technicians in the next two years will, in most branches, be about twice the number of existing vacancies. In metal manufacture the two year demand is forecast at nearly four times the current vacancies—an increase of nearly 20% on current strength. These facts emerge from a Ministry of Labour survey of 400 firms which together employ about 22% of the total labour force in the engineering and chemical industries. Nearly 18% of their employees were engaged on managerial, administrative and clerical work, and 71% were craftsmen semi-skilled or unskilled workers. Technicians constituted 8·7% of the employees, compared with 2·1% who were qualified scientists and engineers.

Industries showed considerable variations in the proportion of technicians to the total number of employees. The highest proportion, 11·6% was in electrical engineering and electronics.

MATERIALS HANDLING

FOLLOWING the success of their first conference last year, the Institute of Materials Handling have decided to hold a second international conference at Southport from 10 to 12 May. Delegates will visit factories in the Lancashire and Cheshire areas during the conference.

Sayings OF THE WEEK

"The politician's idea is that if he can scrap trade agreements to control prices, competition between manufacturers' merchants and retailers will become intense, prices will be cut and he will be able to present himself to the voters as the man who has reduced the cost of living. Unfortunately, however, this rather naïve idea has certain disadvantages." . . . MR A. W. Moss, chairman and managing director, H. Frost and Co., writing to *The Times*.

"We must have more incentives to tackle export markets." . . . MR A. CLARK, chairman, Plessey Co. Ltd.

PRICES of cable metals and other materials

Figures quoted are the official prices ruling on Tuesday, January 3

	£ per ton	Weekly change £
COPPER, standard class A (settlement)	226½	−4
" (3 months)	225½	−2½
LEAD, refined pig, 99·97% purity (cash)	63½	−½
" (3 months)	64½	−1½
TIN, refined, min. 99·75% purity (settlement)	790	−3
" (3 months)	790½	−½
ALUMINIUM, ingots 99·99·5%	186	—
" wire bars (4×4×54")	193½	—
BRASS Strip 63/37	199½	−3½
SILVER (Troy oz)	79½d	−½d
ZINC, virgin, min. 98% purity (cash)	80½	−½
" (3 months)	79	−2½
RUBBER, per lb		
No. 1, RSS, spot	26½d	+1d
c.i.f. basis, ports, March	26½d	+1½d
ARMOURING:		
Galv. Steel Wire (0·104 in.)	68	—
Mild Steel Tape (0·04 × 1½ in.)	53*	—
NICKEL (home)	600	—
MERCURY (76 lb flask)	69½	—
AMERICAN PRICES:		
Copper, electrolytic (per lb)	30c	—
Lead, (New York)	11c	—

* *Tape Price, now an average, includes varnishing*

NUCLEAR TRANSLATION POOL

THE European Atomic Energy Community (Euratom), the UKAEA and the US Atomic Energy Commission have agreed to pool their efforts to collect and disseminate information concerning translations of nuclear literature, especially from such languages as Russian and Japanese. A central information office, "Transatom," has been established at Euratom's Brussels headquarters. It will function in two ways: first, by publishing a monthly, *Transatom Bulletin*, which will list existing translations recently reported to the Brussels office as well as new translations planned by international or national institutions and private firms in the European community, the US, UK and in other countries.

Secondly, all data relating to translations are being collected and recorded in a master file system at Brussels. The bulletin is available on a subscription basis from 51 Rue Belliard, Brussels, at $8 per annum ($16 air mail).

Contacts have been established in order to avoid duplication of work when the European translation centre, to be established at Delft, Holland, is set up. The scope of this institution is much wider; it will cover all scientific and technical matter in the field of exact sciences.

I.E.A. Schedule Nuclear Meetings

THREE scientific conferences and seven symposia for 1961 have been announced by the International Atomic Energy Agency. Two of the conferences are of electrical interest. One concerns nuclear electronics and will be held in Belgrade from 15 May to 20 May. The other is on plasma physics and controlled nuclear fusion research. This is planned for the first week of September, 1961, and will probably be held in Salzburg.

Amongst the minor meetings announced is a seminar on fast and intermediate reactors to be held in August at a venue as yet undecided; a meeting on treatment of high level radio-active wastes scheduled for September, again at an undecided location; and finally in October a symposium on advanced power reactor designs and experiments.

BICENTENARY

ESTABLISHED in 1760, initially specialising in fine interior décor, Marsh Jones and Cribb Ltd., of Leeds, have just celebrated their bicentenary. The Electrical Division added to the company's activities in July, 1948, now undertakes all types of contracting work, including a maintenance service and is the responsibility of Mr J. R. Hall, engineering director.

News in Brief

Eddystone lighthouse has a new 750,000 candle power flash, powered by a diesel generating set, to replace the paraffin pressure lamp which has been in service for 78 years.

Irish Cables Ltd., in conjunction with the Newcastle, County Down, Technical School, has started a new five year apprenticeship scheme.

The Midland Electric Manufacturing Co. propose to start production at their Holyhead factory this month.

Ferranti Ltd. have arranged to lease the Corn Exchange, Dalkeith, for two years as a training ground for the Thornybank factory.

Photoelectric controlled street lighting has been installed along part of Derby Rd, Beeston.

J. G. Statter and Co. have recently received £100,000 worth of repeat orders for switchgear, including £40,000 for Johannesburg municipality, £21,000 for Malaya's Central EB and £38,000 for Admiralty docks.

Chloride Batteries Ltd. supplied standby batteries for the new Leicester (Wharf St) telephone exchange opened recently.

Aiton and Co. Ltd. have been awarded the contract for steam, feed and circulating water pipework at Trawsfynydd nuclear power station.

The enlarged and modernised service centre at Minehead, of the South Western Electricity Board, was opened recently.

OVERSEAS NEWS

from our correspondents abroad

CANADA

230 kV Line Construction

Recently, construction work began on a 48 mile 230 kV double-circuit transmission line linking Orangeville to Hanover. This first constructional stage is scheduled for completion by October and will be followed by a second stage, 31 miles long, linking Hanover to the Douglas Point nuclear power station. Estimated cost of the first stage is $4·5 million. The line will help to meet rapid demand increases in the Hanover district.

BC Raise Hydro Levy

Under new water rights regulations, power generation in the United States from the Columbia River scheme would provide an estimated $480,000 per year in revenue when it is completed. The new levies increase revenue on water stored for power production in British Columbia and also put a charge on installed hydro capacity as well as actual production. The fees are payable by the storage operator, that is, the BC Power Commission and an idea of what the new rates will mean is given by a rise from $10 to $3,000 per year for the projected High Arrow reservoir.

Columbia and Peace Inquiry

An unexpected move in the controversy over the relative merits of the Columbia River and Peace River projects and how they are to be financed, occurred last Saturday when the British Columbian Government gave the task of defining power costs to consumers for the two schemes to the BC Energy Board. The Energy Board are to inquire into all phases of both developments in an attempt to resolve the difference of opinion concerning relative benefits accruing from the Columbia River project, backed by the Federal Government and favoured by the USA, and the private Peace River scheme sponsored by Wenner-Gren interests.

Columbia River Controversy

The thorny question of how the $458 million Columbia River hydro-electric development is to be financed received another twist recently when the Federal Government repeated their loan offer. The Federal Government are offering to provide $172 million or about half the cost of building the dams for the project at the open market rate of interest. The Federal Government have flatly rejected the BC Premier's request for an outright grant. At one stage, the Federal Government asked for a ½% interest rate to cover handling charges, but this is said not to be mentioned in the latest proposals. It is reported that neither is the Federal Government now pressing for a share of the revenue from the project. However, the Government has made it a condition that a joint BC-Federal Agency should be established to administer the project and also to enable the terms of the power treaty with the US to be guaranteed.

The British Columbia Government have again rejected the Federal offer and are prepared, according to the Premier, Mr Bennett, to go it alone. This is thought to imply in some quarters abandonment of the Columbia scheme in favour of the private Peace River venture. Recently it was announced that work on the Peace River scheme would begin in May.

U.S.A.

GB Loses 800 MW Set Contract

Contracts for two 800 MW turbo generator units, said to be the largest in the world, have been awarded to the American General Electric Co. General Electric's bid was the lowest American offer received and was less than half of the 20% margin allowed to domestic steam turbine builders over foreign bids. Valued at nearly £11 million, the contracts have been awarded by the Tennessee Valley Authority. Unsuccessful bids were submitted by the British firms AEI and C. A. Parsons.

Japan Seeks Typhoon Proofing

Engineers from the Japanese Electric Power Development Co. are at present investigating ways and means to make electrical installations typhoon-proof. Leader of the delegation which is now in Florida said that following serious typhoons, of which there were three last year, the company's installations were under repair for two months.

BRITISH GUIANA

Takeover Plan Complete

Final arrangements for the takeover by the British Guiana Government of the Canadian owned Demerara Electric Co. are now completed. The Demerara Co. supplies electricity to Georgetown and its suburbs. The Government is to make a down payment of about £250,000 to the Power Co. of Canada, who own the undertaking, and the balance of the purchase price, about £1 million, will be paid over about four years from the company's profits. The Government has also arranged for deferred payments on the £2 million loan for financing extensions to Demerara power station. These extensions are being carried out by a consortium consisting of AEI, Taylor Woodrow and International Combustion.

U.S.S.R.

Electricity Plans for 1961

An increase of 7,800 MW in the electrical capacity of the Soviet Union is included in the Supreme Soviet's plans for development in 1961. It is proposed to start construction on two thermal stations with capacities of 2,400 MW. Hydro-electric developments in the new year will include the first constructional stages of the Kiev Dam in the Ukraine and the Nurek Dam in Tadjikistan.

Railway Electrification

Electrification of the important railway line from Moscow to Donbas has just been completed. Work is also nearing completion on the electrified line, 3,400 miles long, linking Moscow to Irkutsk. Diesel and electric trains are now said to be handling 40% of Soviet railways goods traffic.

RHODESIA

Tariff Equalisation Impracticable

Recommendations for the electricity supply industry's organisation in the Federation are contained in a report submitted to the Federal Assembly by Sir John Hacking, of Merz and McLellan, and Mr J. S. Clinton. The report says that tariff equalisation would be quite impracticable and that low tariffs should be retained in the area supplied by Kariba. The present tariff differentials made it possible to discourage uneconomic developments in areas remote from Kariba. Any attempt to equalise tariffs would involve large increases in tariffs of the undertakings obtaining their supply from the Kariba system.

The report advises that ownership of generating stations connected to the Kariba transmission system should be transferred to the Federal Power Board. The Board should generate in bulk from major hydro and thermal resources and transmit in bulk to licensed authorities. Territorial electricity supply commissions, says the report, should take energy from the Board and supply local authorities and statutory bodies. It is further advised that total revenue paid into the general fund by municipal undertakings should be limited to 4%. The report advises that steps should be taken to increase tariffs immediately in Southern Rhodesia. The report finds that the Electricity Council for Southern Rhodesia has not been able to deal effectively with proposed tariff increases although such increases have operated rather more satisfactorily in the northern territories. It is also recommended that the three Councils be disbanded. In Northern Rhodesia, some form of body should be established to co-ordinate activities of

the four area boards. The Government, in consultation with the Territorial Governments, are now examining the report's recommendations.

BURMA

Electrical Export Survey

Export of domestic appliances to Burma is hampered both by the high cost of electricity, ranging from 3d to 8d/unit, and restrictions imposed by the Government's import licensing policy. These facts are given in a market report published in the Export Service Bulletin for December. There is little market for labour-saving domestic appliances and, although electric fans are widely used, most are imported from Japan under war reparations agreements. The demand is small for domestic heating appliances. Electric kettles, toasters and small electric cookers with one or two rings are most in demand.

PAKISTAN

Power Station at Sukkur

Plans for a 30 MW power station at Sukkur are being prepared by H. G. Acres, consulting engineers of Niagara Falls, Canada. The station will supply power to villages and towns within a radius of 75 miles and is estimated to cost Rs5.03.00.000. The Canadian Government has promised financial aid and construction work will begin in the near future. In making the announcement, the Government of West Pakistan also referred to diesel plants in commission or under construction which included a 1 MW installation at Larkana, a 370 kW installation at Khairpur and a further 200 kW plant at Nawabshah.

INDIA

Priority on Rural Power

Commenting that out of 550.000 villages only 44.000 had been electrified under the first and second Five Year Plans, the central committee on community development agreed that much higher priority should be given to electrification in rural areas.

Uniform Tariff Prophecy

A reasonably uniform electricity tariff might be expected to develop in India when electricity undertakings eventually come under public ownership. This was stated by the Minister of Irrigation and Power in New Delhi recently. He added that proposed introduction of regional grids would enable cheap hydro power to be made available in some areas now served by diesel plants.

Village Power Committee

Representatives of the Planning Commission and Central Ministries will constitute a committee to be formed shortly for studying rural electrification. They will be particularly concerned with the extent to which cost of electricity supply for villages can be subsidised.

AUSTRALIA

Murray Soil Tests Completed

Commenting that foundation soil tests for the vast River Murray Dam scheme had been successfully completed, the Premier of South Australia added that construction work on the dam might begin within 12 months. The dam will take an estimated 2½ years to complete and will impound a volume of 4½ million acre ft. The site is 37 miles upstream of Renmark.

Possible Supply in East Gippsland

A conference to explore the possibility of NSW power being supplied to East Gippsland may enable power to be taken to the Bendoc border districts of the Orbost shire. Preliminary work on power line routes is proceeding and it is reported that a £200.000 loan for these lines was subscribed fully last May.

Plea for Hydro Development

Speaking in Parliament recently the Liberal leader advocated early development of the full hydro-electric power potential in Tasmania. Such development, he thought, would increase the State's capacity for employment and he said that if permission had been granted, the Consolidated Zinc aluminium development could have been supplied as cheaply with hydro power in Tasmania as in New Zealand. Without such special development, it was unlikely that Tasmania's hydro potential would be developed for at least 20 years and by that time it would probably not be competitive with nuclear power.

Derwent River Hydro Possible

Possibilities of hydro developments on the Derwent River in Tasmania are being examined by the Hydro-electric Commission. The development would involve three dams below the existing dam at Catagunya.

NSW Sales Rise

A surplus of £483.845 on a total income of just over £48 million is recorded by the NSW Electricity Commission for the year ended last June. Sales rose by 10·8% to 7,060 million kWh, but the price per unit fell from 1·679d to 1·62d. Addition of 155 MW of generating plant during the year brought the installed capacity to 1,851 MW.

Victoria Grid

Another stage in the comprehensive electrification of Victoria ended with the completion recently of the 75 mile Bendigo to Kerang high voltage line. A survey has also been completed on the Kerang to Redcliffs 140 mile line and tenders for tower erection and conductor stringing are being requested.

The recently completed Calgary Power 63,000 h.p. hydro station at Rundle. The tail race canal discharges into the Bow River near Canmore

Water from Spray Lakes reservoir, near Banff, falls through a 905 ft head to the new second turbine at the company's Spray plant, raising the capacity to 124,000 h.p. A special "TI" high-tensile steel 8½ ft pipe is used

Company Activities

AFTER the party, the hangover. And this was how it was last week, the last few days of 1960, on the London Stock Exchange. Business was down to a minimum and nothing at all to write home about except possibly continental rumours that Imperial Chemical Industries is planning a mammoth money raising "rights" or debenture issue in the not too distant future. Too much like too much Christmas pudding such a possibility laid a leaden hand on the level of equity prices. Nor did news of the Steel Company of Wales short-time working help matters.

But the electrical list was nonetheless able to produce one or two fighting finishes to 1960. This was certainly the case with Colvern, the Romford makers of components for the electronics industry, whose 5s Ordinary shares finished the week 3s stronger at a new all time high of 53s, representing a 14s 10½d gain from the year's low of 38s 1½d. News here was a one-for-two free scrip issue and an unchanged interim dividend of 10%, but the big boost was in chairman Mr L. Reddall's accompanying half-time report. Happily, hire-purchase restrictions and other factors which have affected the domestic radio and television industry have made no material difference to the company since its activities are largely concerned with the "professional" side of electronics. Both turnover and profits, therefore, for the eight months ended 30 Nov., 1960, were at a higher level than in the like period of last year. Moreover, with a healthy order book the final results for the year ending 31 March, 1961, should again show an increase over the previous year when a record before tax trading profit of £251,650 was returned. It looks, too, if Colvern will pay a 25% final dividend on the capital as increased by the one-for-two free scrip so that the year's equivalent total dividend will be lifted to 31¼% from the equivalent last time of 23¼%.

Telefusion, too, which rents and sells radio and TV sets, came in for some strong buying, enough to lift smartly the 5s Ordinary shares 1s 9d a time to 30s 3d. This now puts them between their 1960 "high" of 38s 3d and their "low" of 24s 9d. At their current level they are now yielding 4·5% on the 3·4 times covered dividend of 27½%. Considerable expansion was undertaken during the year when Brindle and Kirby (Electrical and Radio Engineers) and Messrs Browns (Llandudno) were taken over. Radio Telefusion was also registered with a view to the group entering the field of commercial radio in the event of the Government giving the "go-ahead." And as recently as September, chairman Mr J. C. Wilkinson was still looking forward to "steady expansion," public demand for television rental was still strong, while far reaching commercial and technical developments can be expected within the next few years. The group, based on Blackpool, also operates branches in London and in various areas in the provinces.

Elsewhere, Plessey gained a few pence at 49s, with their interest in the development of the Ferguson hydraulic torque converter the main talking point, and Pyrotenax were 9d to the good at 47s 3d. Some cinema shares, however, such as Rank Organisation at 21s 1½d, were easier on the continuing decline in cinema attendances, while EMI, following a minor setback on Wall Street, gave bargain hunters a further chance when the 10s Ordinary shares slipped back 9d to 43s 3d. Even so, the electrical market enters 1961 in not too sorry a state after the squeezings and buffetings of 1960.—*From our City Correspondent.*

Colvern Ltd.

Along with an unchanged interim dividend of 10%, a one-for-two scrip issue is proposed by this firm of manufacturers of component parts for the electrical industry. The directors add that if trading, both at home and abroad, follows existing trends, results for the year ending 31 March next should show an increase over the previous year. In this event they may recommend a final dividend on capital, as increased by the scrip issue, at the same level as last year (25%). Both turnover and profits for the eight months to 30 Nov. last were at a higher level than the corresponding period of last year, with a most healthy order book. A factory extension, the cost of which is being met out of liquid assets, should be completed towards the end of 1961. The acquisition in September of the Childen Engineering Co. was satisfied by an issue of Colvern shares and resulted in a credit of £30,625 to share premium amount.

Dussek Brothers and Co.

A controlling interest has been acquired in Claud Campbell and Co., an old firm of wax specialists which has been merged with Waxes Ltd., an existing Dussek subsidiary. Henceforth the amalgamated business will be carried on under the title of Claud Campbell Waxes Ltd.

Hartley Baird

This concern, which is controlled by the Camp Bird group, propose to increase the authorised capital to £1¼ million partly for the purpose of acquiring Limit Engineering (a Camp Bird subsidiary). The board has also decided that it would be in the best interests if H. J. Baldwin and Co. Ltd. became a wholly owned subsidiary, and to this end it is proposed to make an offer to outside shareholders in the near future. Hartley Baird, of course, is largely a holding company, dependent for its profits from its subsidiaries. H. J. Baldwin suffered severe and unexpected loss in the past year and £9,000 had to be written off the value of stocks of refrigerators. The sales staff in this sphere, too, has been reduced, and in future the company is to concentrate on electric blankets and heating elements, in which the future seems reasonably assured.

Kenwood Manufacturing Co.

Bank overdrafts at 31 July last amounted to £1,320,000, it is shown in the full accounts. Current liabilities total £2,380,000, and Mr J. H. Senior, chairman, tells shareholders that the unbalance between the current and fixed assets will be corrected by measures which the directors propose taking in due course. Since the date of the balance sheet, the Kenwood board have arranged a "lease-back" deal on a freehold factory now being built. As a result, Kenwood have received back the £78,000 spent up to the end of July, and liabilities for another £190,000 have been taken over by the buyer and excluded from the group capital commitments (which stood at £226,000). The greater part of the latter figure refers to plant and machinery which are being covered by hire-purchase agreements.

Bruce Peebles and Co. Ltd.

Warning that an Ordinary dividend for 1960 is unlikely, because results for the year have been seriously affected by delays in delivery of important items of plant, is given in a circular to stockholders. The management had earlier believed that delivery of new plant then on order would be effected in time for beneficial use by the middle of 1960 and that much of the extensive reorganisations then in process would soon yield results. But the plant is not yet available. Some of the benefits of reorganisation are only now evident and others must await arrival of the new plant. But the board has confidence in the company's future; the order book position is satisfactory and the rate of order intake encouraging. It is also announced that talks have been taking place between the board and the directors of the Belmos Co. Ltd. with a view to a merger (see also page 27).

Warsop Power Tools Ltd.

Development work on the long-term project has reached prototype stage and is giving cause for satisfaction, Mr W. B. Cullen, the chairman, reports, but it is too early to predict when the tool will be ready for marketing. In addition, development expenditure is being incurred on another project.

Dividend Declared

Greenwood and Batley. Interim 5% (*same*).

COMMERCIAL INFORMATION

Contracts Open at Home . . .

Dates given are the final for receipt of tenders unless otherwise stated.

5 Jan.—Boston B.C. Electrical works for 56 dwellings. Borough Engineer.

6 Jan.—Edinburgh C.C. All trades or individual trade basis: (5) Electrical work in proposed new pavilion, Wardie Recreation Ground.—See 29 Dec. issue.

7 Jan.—Willesden B.C. Supply of (Item 1) cable, conduit and lamps for year to 31 March, 1962.—See 29 Dec. issue.

9 Jan.—Brislington. Electrical installation in new office and warehouse for Bill Switchgear Ltd. Applications to architect: E. F. Tew, 11 Belmont, Bath, by above date.

9 Jan.—Hillsborough R.D.C. Electrical installation in erection of sewage disposal works at Newtownbreda.—See 29 Dec. issue.

9 Jan.—Skipton U.D.C. Rewiring of 83 pre-war houses, Shortbank Rd.—Advertised 29 Dec. issue.

9 Jan.—West Lancs R.D.C. (a) Supply of 55 Class "A" and 527 Class "B" concrete columns/brackets; (b) supply of 140 W sodium and M.F. Class "B" lamps/lanterns/transformers/capacitors; (c) erection of columns/brackets, fitting and wiring of electrical equipment and commissioning plus removal of redundant equipment.—Advertised 22 Dec. issue.

10 Jan.—Burnley. Supply of electrical equipment and furnishings for Fir Grove Hostel. Social Services Officer, 50 Manchester Rd.

10 Jan.—Listowel. (b) Electrical installation comprising 175 lighting points, 90 power points for 170 h.p., five clocks and telephone wiring at new factory at Listowel, Co. Kerry.—See 29 Dec. issue.

10 Jan.—Luton B.C. Electrical installations in Gooseberry Hill and Leagrave High St clinics. Borough Architect, Town Hall.

10 Jan.—Stoke-on-Trent T.C. Minor electrical installations at Queen's Pk, Longton, and (c) provision of external lighting at College of Bldg, Cauldon site works. Applications to City Architect, Kingsway, by above date. Deposit £2 each contract.

11 Jan.—Worthing B.C. Supply of (Item 13) tungsten and discharge lamps. Borough Engineer, Town Hall.

13 Jan.—Clogher R.D.C. Electrical installations: in 42 houses, Aughnacloy and Fivemiletown; 12 houses, Crossowen. Details from architects: Munce and Kennedy, 133 University St, Belfast 7. Deposit £2 2s.

13 Jan.—Doncaster R.D.C. Contract 363, fixed-price basis. Supply and installation of 140 W sodium lamps/gear on 25 ft prestressed concrete columns (1) 44 units, A1, at Rossington Bridge; and (2) 53 units, A18, Thorne Rd, Edenthorpe.—See 29 Dec. issue.

13 Jan.—Folkestone B.C. Contract 1(b). Hot-water system installation including electric water heaters and installation of power points for modernisation scheme in pre-war houses.—See 29 Dec. issue.

14 Jan.—Brighouse B.C. Supply of (a) 50 3½ cu ft refrigerators and/or (b) 50 2½ cu ft refrigerators on a ten years' maintenance basis. Alternative quotations for free standing and built-in units, in which case price is to include wooden frame. Town Clerk, J. R. Liddle, Town Hall.

14 Jan.—West Lothian C.C. Supply and erection of 25 200 W long type sodium lanterns on 35 ft steel columns/brackets along A8, near Bangour Hospital.—See 22 Dec. issue.

16 Jan.—Birmingham Tame and Rea. Three 1,500 g.p.m., two 140 g.p.m. and three 70 g.p.m. centrifugal pumps complete with motor control gear.—See 22 Dec. issue.

16 Jan.—Brighton B.C. Electrical installation at Preston Technical Institute, Coombe Rd. Borough Surveyor, Engineer and Planning Officer, 26-30 King's Rd. Deposit £1 1s.

16 Jan.—Gillingham B.C. Supply of (Item 16) switches and accessories; (17) conduit; (18) wire, cables and accessories; (19) lamps for year. Borough Engineer, Municipal Bldgs.

16 Jan.—Hayes and Harlington U.D.C. Supply of (Item 16) conduit, fittings and accessories; (17) discharge lamps; (18) g.l.s. and vehicle lamps; (19) concrete and c.i. lighting columns; (28) time switches; (31) vehicle batteries; (37) time switch repair for year to 31 March, 1962. Engineer and Surveyor, Town Hall.

16 Jan.—Manchester C.C. Supply of (Item 3) fittings, plugs, sockets, connectors, etc.—See 29 Dec. issue.

16 Jan.—Prestwich B.C. Supply of (Item 10) lamps for year.—See 22 Dec. issue.

17 Jan.—Irvine B.C. Supply of 400 three-plate cookers and 400 wash-boilers.—See 29 Dec. issue.

17 Jan.—Newcastle upon Tyne C.C. Supply and installation of two automatic passenger lifts in each of two 15-storey blocks of flats at Longbenton estate.—See 8 Dec. issue.

17 Jan.—Tunbridge Wells B.C. Supply of lamps for year.—See 29 Dec. issue.

18 Jan.—Wallasey B.C. Supply of (Item 14) cables and (Item 15) lamps for year to 31 March, 1962. Borough Engineer and Surveyor, Town Hall.

19 Jan.—Cregg, Co. Sligo. Electrical installation, including laundry and cooking equipment, motive power supplies, radio distribution, internal telephones and fire alarm system at Home and School of the Immaculate Conception.—See 29 Dec. issue.

20 Jan.—Aberdare U.D.C. Supply of (Item 14) lamps for year.—See 29 Dec. issue.

20 Jan.—Belfast C.C. Supply of (Form 1) turbine oil; (2) insulating oil; (3) firebricks, fireclay, etc.; (5) carbon brushes; (6) wire rope; (8) glazed ducts, fibre conduit and covering tiles; (9) distribution and street lighting control pillars; (10) 6·6 kV switchgear; (11) meters, instrument transformers, etc.; (12) m.d. indicators; (13) time switches; (14) l.t. fuse units, service cut-outs and accessories; (15) distribution transformers; (16) cables, joint boxes, cleats and ferrules; (19) kettles; (21) cookers for year from 1 May, 1961.—Advertised 29 Dec. issue.

20 Jan.—Port Talbot B.C. Street lighting conversion from gas at (a) Baglan estate and Sunnycroft Rd areas; (b) Taren Terr to Viaduct Pontrhydfen and district roads; (c) replacement of Group "B" lighting, Tyr Owen Row to Taren Terr, Cwmavon, B4286. Borough Engineer and Surveyor, Municipal Bldgs.

21 Jan.—Frimley and Camberley U.D.C. Supply of (a) 90 Group "A" concrete columns and/or (b) 280 140 W sodium lamps/lanterns/control gear.—Advertised 29 Dec. issue.

21 Jan.—Sunderland B.C. Electrical installation in Humbledon Training Centre. Borough Architect, Grange Hse, Stockton Rd.—Advertised in this issue.

23 Jan.—Carmarthen B.C. Removal of existing installation and supply and erection of 109 Class "A" 140 W sodium lighting units on steel columns on A40 and B4312. Borough Engineer and Surveyor, Municipal Offices, John St. Deposit £2 2s.

23 Jan.—Chelmsford B.C. Supply and erection of 24 35 ft steel columns with 200 W linear sodium lanterns and ancillary work. Borough Engineer and Surveyor, Municipal Offices, Coval Lane. Deposit £1 1s.

23 Jan.—Grimsby B.C. (c) Electrical installation, on fixed-price basis, in remodelling of Edward St Primary Junior School. Borough Engineer and Surveyor: J. V. Oldfield, Municipal Offices, Town Hall Sq. Deposit £5.

23 Jan.—Swansea B.C. Supply of cable, lamps, steel and concrete pillars and other public lighting equipment.—Advertised 29 Dec. issue.

23 Jan.—Twickenham B.C. Supply of street lighting columns and fittings, cables, conduit and lamps for year. Engineer and Surveyor, Municipal Offices.

23 Jan.—West Riding C.C. (8) Provision and installation, by contractors on N.I.C.E.I.C. roll, of floodlighting at Pudsey Grammar School. Details from Divisional Architect, Salisbury Bldgs, Albert St, Harrogate.

26 Jan.—Ealing B.C. Electrical installation renewal, by contractors on N.I.C.E.I.C. roll, in Stanhope Primary School, Mansell Rd, Greenford. Borough Engineer, Town Hall, W.5. Deposit £1.—Advertised in this issue.

27 Jan.—Oldbury B.C. Supply of (Item 18) lamps and fluorescent tubes for year. Borough Engineer and Surveyor, Municipal Bank Chmbrs.

28 Jan.—Camborne-Redruth U.D.C. Supply of (Item 24) electrical equipment and fittings for year.—See 8 Dec. issue.

28 Jan.—Otley U.D.C. Supply and erection of 95 tubular steel columns/brackets with 400 W colour-corrected mercury side entry

Your Queries Answered

Readers are invited to make use of our free enquiry department which possesses wide resources, including an index of trade information with over 100,000 entries

A Selection from the 109 queries answered this week

"Barnes" transformers — makers of? C.E.G.B.—Thomas Barnes (Finchley) Ltd., 115 Woodhouse Rd, N.12.

"Kynal" soldering flux—makers of? E.E.—Fry's Metal Foundries Ltd., Tandem Wks, Merton Abbey, S.W.19.

"Corona" pumps—makers of? T.E.—James Beresford and Son Ltd., Kitts Green, Birmingham 33.

"Aston" switchgear — address for? W.W.—William McGeoch and Co. Ltd., Warwick Wks, 46 Coventry Rd, Birmingham 10.

"Hilti" fastening tools—suppliers of? G.B.—Ucan Developments Ltd., 62 Hill St, Richmond, Surrey.

"Candy" washing machines—suppliers of? R.S.—Salvicta Ltd., 25 Hatton Gdn, E.C.1.

"Noxi" pumps—agents for? E.T.—Henry Wilson and Co. Ltd., Kirkby Industrial Estate, Kirkby, nr. Liverpool.

"Vactric" appliances — address for spares? E.M.E.B.—Vactric Ltd., 35 Sunbeam Rd, N.W.10.

Commercial sink garbage disposal units—makers of? W.L.—W. and G. Sissons Ltd., St. Mary's Rd, Sheffield 2; The Imperial Machine Co., Victoria Wks, Edgware Rd, N.W.2; Foodtech Ltd., Queen Anne's Pl, Bush Hill Park, Enfield, Middx; Haigh Eng. Co. Ltd., Alton Rd, Ross-on-Wye, Herefordshire.

lanterns/lamps/gear along 1·8 miles, A660. Engineer and Surveyor, North Parade. Deposit £1 1s.—Advertised in this issue.

28 Jan.—Rhyl U.D.C. Supply and installation complete of: (a) two 1,560 g.p.m. sewage pumps, two 8,250 g.p.m. and two 12,450 g.p.m. storm water pumps with motors, starters, pipework, valves, etc.; (b) one 800 b.h.p. stand-by diesel-alternator (alternatively, supply only of diesel-alternator).—See 22 Dec. issue.

1 Feb.—Newcastle upon Tyne C.C. Provision of lightning protection for two blocks of 15-storey flats at Longbenton estate, Unit 4.—See 29 Dec. issue.

3 Feb.—Belfast C.C. Supply and erection of air heater cleaning equipment at Power Station West. Tender form N.2484 from consulting engineers, Merz and McLellan, Carliol Hse, Newcastle upon Tyne 1. Deposit £5 5s.—Advertised in this issue.

6 Feb.—Wrexham B.C. Supply of (a) 130 c.i. 15 ft columns/brackets; (b) 100 totally enclosed lanterns; (c) 100 chokes and capacitors for 80 W m.v.; (d) 100 80 W colour-corrected m.v. lamps. Borough Engineer and Surveyor, 31 Chester St.—Advertised in this issue.

8 Feb.—Southwark B.C. Supply of (Item 8) lamps. Town Clerk, E. J. Pitt, Town Hall, Walworth Rd, S.E.17.

10 Feb.—Bishop Auckland U.D.C. Supply of (Item 18) lamps for year. Engineer and Surveyor: F. Mole, "The Elms," Silver St.

27 Feb.—Newcastle upon Tyne C.C. (1) Electrical installation and (3) one automatic passenger lift for Home for Aged Persons, Section "D," Montagu estate.—See 29 Dec. issue.

28 Feb.—Dunbartonshire. N.A.T.O. Infrastructure contract, Slice VI Naval base installations, value £100,000: (a) installation of 11 kV switchgear, supply and installation of transformers; (b) H.V. and M.V. mains cabling; (c) building installations; (d) lightning conductors; (e) cathodic protection; (f) street lighting. Applications, quoting reference N.A.T.O. C.I. Job No. 3 (Subcontract Electrical Installation), to Director-General, Navy Wks, Admiralty, Chamberlain Way, Pinner, Middx.—Advertised in this issue.

No date stated—Loch Lee Water Board. Supply and installation of switchboards, wiring, lighting and heating installations for first phase Loch Lee scheme.—See 15 Dec. issue.

No date stated—North of Scotland H.E.B. Supply and erection of 132 kV steel tower double circuit spur line to Burghmuir.—Advertised 8 Dec. issue.

No date stated—Peebles B.C. Electrical subcontract in Manor Water Improvement Scheme, Bonnycraig Filter Station. Applications to consulting engineers, Babtie, Shaw and Morton, 17 Blythswood Sq, Glasgow C.2.

. . . and Overseas

*Details of items marked * may be obtained on application to the Board of Trade, Lacon Hse, Theobalds Rd, W.C.1, quoting reference.*

14 Jan.—Greece. 22,900 metres cables. State Procurements Service, 50 Socrates St, Athens. B.o.T. (ESB/33160/60).*

16 Jan.—Pakistan. 80,620 yd aerial cable. Mr F. Rizwi, Purchase Co-ordinating Officer, Block 32, P. and T. Directorate-General, Karachi. B.o.T. (ESB/32854/60).*

16/17/18 Jan.—Pakistan. Diesel generators 10 and 20 kW (7 items). Chief Controller of Stores, Eastern Bengal Railway, Pahartali. B.o.T. (ESB/33357/8/9/62/65/67/99/60).*

17 Jan.—India. Lighting for Rihand Grid substations. Director of Designs, H.E. Design Directorate, 10/489, Allengunj, Kanpur. B.o.T. (ESB/33338/60).*

19 Jan.—Pakistan. Two 30 kVA transformers, switchgear and l.t. switchboard. Chief Controller of Stores, E. Bengal Railway, Pahartali. B.o.T. (ESB/ 33360/60).*

24 Jan.—India. One 60 ton, three 30 ton and five 5 ton o/h travelling cranes. Director-General of Supplies and Disposals, Shahjahan Rd, New Delhi. B.o.T. (ESB/ 33337/60).*

29 June—Australia. Two 550 klb/hr pulverised coal-fired water tube boilers and structures. W.A. Tender Board, 74 Murray St, Perth. B.o.T. (ESB/33383/60).*

31 Jan.—India. 11 kV capacitors. Chief Engineer (South), Stores Purchase Section, Punjab S.E.B., The Mall, Patiala. B.o.T. (ESB/33157/60).*

1 Feb.—Australia. Ten 900/1,000 h.p. diesel-electric locos. Secretary, Victorian Railways, Melbourne C.1. B.o.T. (ESB/33690/60).*

1 Feb.—Kuwait. 11 kV o/h line ironwork, insulators, switchgear and wood poles. Department of Electricity, Water and Gas. B.o.T. (ESB/33819/60).*

1 Feb.—India. One 120 ton, two 5 ton and one 40 ton o/h travelling cranes. Director-General of Supplies and Disposals, Shajahan Rd, New Delhi. B.o.T. (ESB/33602/60).*

8 Feb.—Trinidad and Tobago. Steel stay wire (2 items); p.v.c. insulated aerial cable (5 items); insulators; guy hooks; stay swivels; insulating oil; o/h line accessories (4 items); earth rods and 12 kV underground cables and accessories. E.C. P.O. Box 121, Port of Spain. B.o.T. (ESB/ 33609 to 33625/60).*

10 Feb.—S. Africa. 40,000 ft weldless steel conduit for Municipal Telephone Department, Town Clerk, West St, Durban. B.o.T. (ESB/32846/60).*

17 Feb.—S. Africa. Telephone cable, three items. Town Clerk, West St, Durban. B.o.T. (ESB/32844/60).*

19 March—Egypt. Mechanical and electrical equipment for pumping stations including transformers. Assistant Under-Secretary of State of the Mechanical and Electrical Department. B.o.T. (ESB/33313/60).*

TRADE NOTES

Changes of Address. All correspondence for Moffats Ltd. should now be addressed to the new head office at 35 Davies St, W.1. Telephone: Hyde Park 3784.

In order to achieve closer co-operation with Technical and Production Departments, the Sales Dept. of J. G. Statter and Co. Ltd. has moved from London to the works at Amersham Common, Bucks.

The Home Sales office of Firth Cleveland Instruments Ltd. has moved to 7 Cleveland Row, St. James's, S.W.1. Telephone: Whitehall 3100.

Change of Name. The title of Weir Valves Ltd. has now been changed to Weir-Pacific Valves Ltd.

Distributors. U.S. Industries Inc. (Gt. Britain) Ltd., New Bond St Hse, New Bond St, W.1, have been appointed sole distributors of "Ferrous" electric arc welding transformers in overseas territories except certain areas where a non-exclusive arrangement exists.

TRADE MARKS

This information is extracted from the Official Journal by permission of the Controller.

Argo-vac. 804,987. Class 11. Low-pressure arc furnaces. Clino Foundry Supplies Ltd., 25 Clyde Vale, Forest Hill, S.E.23.

Burnerd. 794,026. Class 9. Apparatus, etc. F. Burnerd and Co. Ltd., 5 Balfour Pl, Park La, W.1.

Cornalux. 804,567. Class 11. Lighting installations, etc. Philips Electrical Ltd., Century Hse, Shaftesbury Ave, W.C.2.

Digivisor. 808,619. Class 9. Measuring apparatus, etc. Electrical Apparatus Co. Ltd., New Barnes Ave, St. Albans.

Homelight. 804,182. Class 11. Refrigerators, etc. Pye Ltd., Radio Wks, St. Andrews Rd, Cambridge.

Laudeluxe. 807,399. Class 7. Washing, centrifugal drying machines, etc. H. Morris, 186 Greengate, Salford 3, Lancs.

Magicmaid. B802,766. Class 7. Food and drink mixing machines. **Magicold.** B802,660. Class 11. Refrigerators, etc. Berry's Electric Ltd., 85-86 Newman St, W.1.

Morlec. 808,801. Class 9. Apparatus, etc. Morse's Ltd., 10-12 Regent St, Swindon, Wilts.

Solac. 809,368. Class 9. Electrical computing apparatus, etc. The Solartron Electronic Group Ltd., Solartron Wks, Queens Rd, Thames Ditton, Surrey.

Starmatic. 807,349. Class 7. Washing machines. Starmatic Ltd., 128 Seymour Pl, W.1.

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons Ltd., 116 Chancery La, W.C.2.

Alexander Conversions Ltd., 1a Caroline St, Birmingham 3. Motor, marine, electrical, precision and general engineers, etc. Nom. cap.: £100. Dirs.: Michael A. H. Christie and Kenneth Nightingale.

Heaton Power Valve Co. Ltd., Bradford Rd, Brighouse. Manufacturers of and dealers in valves for the control of liquids and gases, etc. Nom. cap.: £1,000. Dir.: David K. Heaton.

Holland Electrical (Dorking) Ltd., The Forge, Ockley, Surrey. Nom. cap.: £1,000. Dirs.: John C. Knight and John Holland.

J.L.S. Sound Systems Ltd., 4 Hardware St, West Bromwich. Nom. cap.: £1,000. Dirs.: John L. Scoltock and Dimphana J. H. Scoltock.

Raymond J. Johnsey Ltd., 2 Wallsall St, Newport, Mon. To carry on business of motor, mechanical, electrical, marine, aeronautical, gas and general engineers, etc. Nom. cap.: £1,000. Dirs.: Raymond J. C. Johnsey and Terence A. Johnsey.

Kevin Electrical Industries Ltd. Nom. cap.: £100. Dirs.: to be appointed by subs. Subs.: James P. Davisson, 65a Fenchurch St, E.C.3; and Leonard M. Carrington, 66 Elmshurst Cres, Finchley, N.2.

Mayfair Electric (Acton) Ltd., 17 Hanbury Rd, W.3. Nom. cap.: £100. Dirs.: Mark A. Winterburn and John Winterburn.

North Court (Electrical Bradford) Ltd., 676 Gt. Horton Rd, Bradford 7. Nom. cap.: £100. Dirs.: Alan Firth and Maureen Firth.

Pulsometer Pumps Ltd., Pulsometer Hse, 20-26 Lamb's Conduit St, W.C.1. Nom. cap.: £10,000. Dirs.: not named. Subs.: John W. Scott and Jeremy P. Raisman.

Rider, Polge and Partners Ltd., 120-121 Newgate St, E.C.1. Electrical contractors and engineers, etc. Nom. cap.: £1,000. Dirs.: Arthur E. E. Polge, Judy B. Rider, Kenneth Stonebridge, Leonard C. R. Dormer and Richard Dormer.

CONTRACTS PLACED

Chester C.C. Electrical work in 40 houses, Plas Newton estate, Engineering Service Installations Ltd., £1,187. Recommended.

Middlesex C.C. Supply and installation of electrical equipment at Deephams Wks, City Electrical Co. Ltd., £54,177. Recommended.

Stockton-on-Tees T.C. Electrical installation in new Hardwick Infant School, Williams Bros., £1,948.

Swinton and Pendlebury B.C. Electrical installations in 76 dwellings on Clifton estate, Wm. Lee, £2,422. Recommended.

Tynemouth T.C. Electrical work in St. Anselm's R.C. Secondary Modern School additions, F. Gray, £369 16s.

BUSINESS PROSPECTS

Aylesbury. Ord, Carmel and Kritzler, 27 Stamford Hill, N.16, architects for £20,000 Tring's Meat Supplies' factory.

Ayr. The Weir Housing Corpn., Coatsbridge, plan 38-acre development of 159 houses at Clockranhill. Cost, £541,250.

Bath. Taylor and Yandell, 18 Whiteladies Rd, Clifton, Bristol 8, architects for £150,000 factory and offices for Horstman Ltd.

Billingham-on-Tees. T. F. Burns and Ptnrs, 3 Ellison Pl, Newcastle, consulting engineers for £¼ million extension scheme planned by Furness Shipbuilding Co.

Bradford T.C. Tender: Ten dwellings in two terrace blocks, Old Park Rd, Thorpe Edge estate. Engineer and Surveyor.

Brighton. The Merchant Princes Co. plan Preston Rd office block.—National Employers Mutual General Insurance Assn., National Employers Hse, Bury St, E.C.3, plan four-storey office block at Richmond Pl.

Buntingford, Herts. P.C. plan £1,000 improvement scheme for street lighting at southern end of town.

Cannock R.D.C. Tender: 19 dwellings, Primrose Park, Pankridge. Engineer.

Carlisle. Corporation to lease site at Willow Holme industrial estate to Eldorado Ice Cream Co., 110 Denton St.—Shop extensions to provide offices planned between Botchergate and Collier La for Carlisle South-End Co-op. Society. C.W.S. Architect's Dept., 90 Westmorland Rd, Newcastle. —T.C. plans youth and community centre at Harraby.

Colnbrook. Burley, Lane and Ptnrs, 66 Gt. Cumberland Pl, W.1, quantity surveyors for Procea Products' extensions.

Cookstown, Tyrone, R.D.C. Tender: 29 dwellings at Blackhill. Quantity Surveyors: F. H. Wright and Ptnrs, 39 Botanic Ave, Belfast.

Croydon. B.T.C., Southern Region, Victoria Stn, S.W.1, plans development of land adjacent Norwood Junc. by erection of office block, staff quarters and telephone exchange.

Dagenham. Westmore and Ptnrs, 121 Cheapside, E.C.2, architects for factory and offices for Glendale Cabinet Co., 555 Commercial Rd, E.1.

Darlington. E. Gordon Crofts, 49 Grange Rd, architect for Charles H. Pugh's McMullen Rd trading estate factory.—E.C. plans additions to the College of Further Education. Architect.

Dartford. Burnham Engineering Co. plan engineering building near Lawson Rd.—London Paper Mills Co. plan factory extensions at Riverside Mills.—Amalgamated Oxides, Victoria Wharf, Victoria Rd, plan welfare block.

Doncaster R.D.C. Tender: 38 houses at Rands La, Armthorpe (Contract 366). Surveyor. Also 25-unit two-storey block of aged persons' flatlets, Charles Cres. Surveyor.

Durham. £30,000 extensions planned to Bede College. Architects: Cordingley and McIntyre, Owengate, Durham City.—Tarren and Caller, 16 Gt. North Rd, Newcastle, architects for planned housing developments at Crossgate.—C.C. plans £134,000 additions to Nevilles Cross training college.

Eccles. J. R. Abson, B.T.C. (London-Midland Region), Euston Stn, N.W.1, estate and rating surveyor, for Staff Association Club at Menton Rd and Wellington Rd.

Egham. Residential accommodation with dining hall and kitchen planned at Shoreditch Training College, Egham, Surrey, for L.C.C.

Gateshead. J. T. Bell, Market St, Newcastle, plan civic restaurant at corner of High St in new development proposals.

Glasgow. William Collins, Sons and Co., 144 Cathedral St, C.4, plan four-storey factory building, Stirling Rd, Cathedral St, etc.

Gosforth. U.D.C. plans two-storey flats at Craster Sq. Surveyor.—A. Craigie and Sons, 20 West Rd, Newcastle, plan six-storey block of 24 flats at The Grove.

Halifax B.C. Tender: Holy Trinity (Controlled) Infants' School. Five classes at Swires Rd. Engineer.

Hanley. Y.M.C.A., Gt. Russell St, W.C.1, plan four-storey Bucknall Old Rd building.

Hemel Hempstead. C. E. Ball and Ptnrs, 36 Fitzroy Sq, W.1, quantity surveyors for £50,000 extensions to Addressograph-Multigraph.

Henley-on-Thames. Davis, Belfield and Everest, 9 Ashley Pl, S.W.1, quantity surveyors for £705,000 admission unit at Borocourt Hospital.

Hexham. Hadrian Supply Co., Norham Rd, North Shields, plan grocery supermarket in Fore St.

Hornsey. B.C. plan new lighting at Archway Rd and Gt. North Rd.

Humshaugh, Northumberland. Tender: Additions to C.E. school. Architects: J. W. Taylor and Son, St. James Bldgs, Gallowgate, Newcastle.

Ipswich B.C. Tender: New primary school off Belstead Rd. Architects: Johns, Slater and Haward, Foundation St, Ipswich.

Isle of Ely C.C. Tenders: Wisbech Queens Girls' School: first instalment of extensions and alterations: Tydd St. Giles: new junior and infants' school. Clerk.

Jarrow. Wm. Leech Ltd., St. James St, Newcastle, plan Breamish St area houses.—B.C. plans 109 houses in Lord St area. Engineer.—Provision of street lighting in overspill area planned, 25 ft poles with sodium lighting on the "spine" road, with 15 ft poles and colour-corrected mercury lamps on secondary roads.

Lanarkshire. B.o.T. plans 25,000 sq ft factory at Shotts.

Leeds. Pashler and Ptnrs, City Chmbrs, Infirmary St, Leeds 1, have been appointed electrical and heating consultants for Lingwell County Secondary School.

London. J. Batty and Son, 142 Minories, E.C.3, architects for warehouse and offices at Houndsditch.—R. Seifert and Ptnrs, 34 Red Lion Sq, W.C.1, architects for office block at junction Gracechurch St with Cornhill, E.C.3.—Alexander Flinders, 306 Wimpole St, W.1, architect for Aldgate High St, E.C.3, offices.—L.C.C. plan £95,000 eight-storey unit workshops at Locksley St, Stepney.—S. E. W. Paton Orr and Ptnrs, 40 Goodge St, W.1, architects for £30,000 showroom/warehouse at Old Kent Rd, S.E.1.—L.C.C. health committee plan three training centres on The Grange Tannery site, Bermondsey, S.E.1.—Richardson and Houfe, 24 Queen Anne St, W.1, architect for five-storey block of shops, restaurant and offices at Whitcombe St.—Bronek Katz and R. Vaughan, 208a Regent St, W.1, architects for eight-storey extensions to Clifton Ford Hotel, Welbeck St, W.1, and a wing of four storeys.—Devereux and Davies, 5 Gower St, W.1, architects for Westminster Bridge Rd, S.E.1, office block for Landfranc Holdings.—Scott, Brownrigg and Turner, 41 Parliament St, S.W.1, architects for eight-storey block offices at Streatham High Rd, S.W.16.—R. S. Grinling, 12c Hornton St, W.8, architect for Bernard Sunley Investment Trust's shops, offices and flats scheme at 98-99 Jermyn St, S.W.1.

Luton B.C. Tender: Multi-storey car park to accommodate 250 cars. Engineer.

Middlesbrough. £65,600 scheme for electric lighting in place of gas on 41 bus routes and principal streets. Further £11,670 planned for lighting on new Council and private housing estates.—T.C. plans bungalows, flats and flatlets at Westerdale Rd, Berwick Hills: shops and ten flats at Easterside: and 185 houses at Ormesby. Engineer.—E.C. plan community centre and library at Harehills Rd, Whinney Janks, at £56,000.—T.C. plans two child welfare clinics at St. Hilda's and Berwick Hills at £7,000 and £13,000. Engineer.

Motherwell and Wishaw. Colvilles Ltd. plan £400,000 offices at Carfin Rd, Craigneuk. Approved by Dean of Guild Court.

Newcastle. R. S. Biskupek, 19 Oxford St, Newcastle, architect for workshop and offices at Fisher St, Walker, for Copley Metal Testing Co.—M. and H. Gatoff, 26 Mosley St, architects for workshops and offices in George St for Black and Decker. —P. J. Stienlet and Son, 4 Queens Sq, architects for conversion of hospital block at Framlington Pl into laboratory block, planned by United Newcastle Hospitals.

Northumberland C.C. £58,000 new junior school planned at Shiremoor. Architect: C. C. Brown, 30 Gt. North Rd, Newcastle.

Pontefract B.C. Tender: 57 dwellings with outbuildings, etc., Carleton Park estate. Engineer.

Portsmouth. T.C. plan £2,600 re-lighting of Hayling Ave.

Poynton. P.C. plan scheme for trunk road lighting on section of London Rd.

Redcar T.C. 270 old people's bungalows planned. Engineer.

Reigate B.C. Tender: 12 four-storey maisonnettes, Cromwell Rd estate, Redhill. Surveyor.

St. Albans. N.W. Metropolitan Hospital Board plans extensions at Cell Barnes Hospital. Architect: F. A. C. Maunder, 40 Eastbourne Terr, W.2.

St. Helens. William and J. B. Ellis, 26 Rodney St, Liverpool, architects for £100,000 headquarters of the Practical Clothing and Supply Co. at College St.

Scarborough. Planned provision of Group "A" standard fluorescent tube street lighting of part of Scalby Rd, A171, now in course of being diverted. Cost £4,722.

Seaton Valley, Northumberland. U.D.C. plans installation of additional socket-outlets in more than 1,800 old council houses.

Sedgefield. Proposed improvements to heating, lighting and power installations at Winterton Hospital may cost £140,000. Local board is Newcastle Hospital Board, Benfield Rd, Newcastle.

Shildon U.D.C. Tender: 21 houses, Jubilee Fields housing estate. Surveyor.

Southall. N.W. Metropolitan Hospital Board plans £125,000 admission ward block at St. Bernard's Hospital. Architects: Tooley and Foster, Midland Bank Chmbrs, Buckhurst Hill, Essex.

Spennymoor. Durham Coal Board (Area 4) plan offices to cost £100,000. Divisional Architects' Department, 24 The Side, Newcastle.

Staveley. James Smith and Co. (Derby), Brewery La, plan new Inkersall Rd factory.

Stoke-on-Trent. Picton Crisps Ltd., Picton St, Hanley, Stoke-on-Trent, plan new Bryan St factory.

Stowmarket. U.D.C. plan improvement to street lighting on trunk road and various minor traffic routes. £5,500 and £6,330, respectively.

Sunderland. £580,000 comprehensive school planned on Hylton Rd Hse estate by E.C. and £110,000 school at North Hylton Rd. Architect: H. C. Bishop, Grange Hse, Stockton Rd.

Surrey. Phase II of development scheme at Merris Wood Farm Institute to include provision of machinery workshop block and biology laboratory. Cost £39,523.

West Hartlepool. Tender for Hexham and Newcastle Diocese: new St. Bede's R.C. secondary modern school, Catcote Rd. Architect: Thomas Crawford, 80 Borough Rd, Middlesbrough.

Westmorland. C.C. plans £200,000 comprehensive school at Calgarth, nr. Windermere.

Weston-super-Mare B.C. Tender: 150 houses, Oldmixon Town development site.

Whitley Bay T.C. Old people's flatlets planned at Seatonville. Engineer.

Widnes B.C. Tender: Branch library at Queen's Ave. Architect.

Wortley R.D.C. Eight blocks of two twin-bedroom flats at Burncross, Chapeltown, near Sheffield. Clerk, Council Offices, Grenoside, Sheffield.

Yeovil B.C. Tender: 42 houses, 12 bungalows. Surveyor.

MEETINGS TO NOTE

THURSDAY, 5 JAN.

I.E.E. Third Hunter Memorial Lecture: "The Application of Electronics to the Electricity Supply Industry," J. S. Forrest. Savoy Pl, W.C.2. 5.30 p.m.

FRIDAY, 6 JAN.

A.S.E.E. (Liverpool and District). Discussion: "Aspects of Electrical Installations and Modern Building Construction." Industrial Development Centre, M.A.N.W.E.B., Paradise St. 7.30 p.m.

MONDAY, 9 JAN.

I.E.E. (Electronics and Communications Section). "Recent Research in Thermionics," G. H. Metson. Savoy Pl, W.C.2. 5.30 p.m.

I.E.E. (Western). "Brushless Variable-Speed Induction Motors." E. R. Laithwaite. South Wales Institute of Engineers, Cardiff. 6 p.m.

I.E.E. (N. Eastern). Third Hunter Memorial Lecture on "The Application of Electronics to the Electricity Supply Industry," J. S. Forrest. Neville Hall, Westgate Rd, Newcastle upon Tyne. 6.15 p.m.

I.E.E. (S. Midlands Supply and Utilisation Group). "The Application of Irradiation in Industry," M. C. Crowley-Milling. College of Technology, Gosta Green, Birmingham. 6 p.m.

I.E.E. (N. Staffs Graduates and Students). "Colour Television," P. S. Carnt. Technical College, Stafford. 7.15 p.m.

E.P.E.A. (London Technical Group). "Computer Techniques as Applied to the Electrical Industry." C. Ayer. English Electric Hse, Aldwych. 7 p.m.

N.E. Electrical Club. "Unusual Applications of Refrigeration," S. B. Warburton. County Hotel, Neville St, Newcastle upon Tyne. 6.30 p.m.

Junior Institution of Engineers (Sheffield and District Section). "Inspection and Testing by Non-Destructive Techniques," D. W. Tasker. Livesey Clegg Hse, 44 Union St, Sheffield 1. 7.30 p.m.

I.E.S. "Modern Aids to Lighting Design—Computer Techniques," H. R. Ruff, H. E. Bellchambers and G. K. Lambert. F.B.I., Tothill St, S.W.1. 6 p.m.

I.E.S. (Sheffield). "Recent Development on the Continent in Exterior Lighting," A. G. Penny. Grand Hotel. 6.30 p.m.

A.S.E.E. (Bournemouth and District). "Heat Pumps," Miss M. V. Griffith. Grand Hotel, Firvale Rd. 8 p.m.

A.S.E.E. (N.W. London). "Road Lighting," S. J. Cooper. Century Hotel, Wembley. 8.15 p.m.

A.S.E.E. (Sheffield). "Safety in the Electrical Industry," G. W. Walliss. Royal Victoria Hotel. 7.30 p.m.

TUESDAY, 10 JAN.

I.E.E. (Measurement and Control Section). "Precision Measurement," G. H. Rayner and A. Felton, supported by "Improvements in the Precision Measurement of Capacitance," G. H. Rayner and L. H. Ford: "The Design of an Audio-Frequency Amplifier for High-Precision Voltage Measurement," S. Harkness and F. J. Wilkins: "The Design and Performance of High-Precision Audio-Frequency Current Transformers," J. J. Hill and A. P. Miller; "Techniques for the Calibration of Standard Current Transformers up to 20 kc/s," J. J. Hill. Savoy Pl, W.C.2. 5.30 p.m.

I.E.E. (Southern). Discussion: "New Semiconductor Devices." The University, Southampton. 6.30 p.m.

I.E.E. (N. Western). "Radiocommunication in the Power Industry," E. H. Cox and R. E. Martin. Engineers' Club, Manchester. 6.15 p.m.

I.E.E. (S.E. Scotland). "The Protection of Electrical Systems," H. G. Bell. Carlton Hotel, North Bridge, Edinburgh. 7 p.m.

I.E.E. (N. Ireland). "Discrimination Betweeen H.R.C. Fuses," E. Jacks. Civil Eng. Dept., David Keir Bldg, Queen's University, Belfast. 6.30 p.m.

I.E.E. (Rugby Graduates and Students). "Production of Semiconductor Power Rectifiers," P. J. Pugh. Rugby College of Engineering Technology. 6.30 p.m.

Institution of Plant Engineers. "Recent Developments in Lighting," H. Hewitt. Royal Society of Arts, John Adam St, Adelphi, Strand, W.C.2. 7 p.m.

Institution of Production Engineeers (East and West Ridings Region). "Tracer Control of Machine Tools," H. C. Town. New Technical College, Doncaster. 7 p.m.

A.S.E.E. (Aldershot and District). "The National Inspection Council," T. Howell. Station Hotel, Basingstoke. 8 p.m.

A.S.E.E. (East Kent). "Transformers and Their Basic Design Principles," J. F. Yates. Clarendon Hotel, Broadstairs. 8 p.m.

A.S.E.E. (Portsmouth and District). "Trunk Dialling System." Committee Rooms, Ministry of Labour Offices, Lake Rd. 7.30 p.m.

I.E.E. (N. Midlands Graduates and Students). Centre Chairman's address, F. W. Fletcher. Leeds and County Conservative Club, South Parade, Leeds 1. 7 p.m.

WEDNESDAY, 11 JAN.

I.E.E. (Southern). "Trends in Electric Motor Controls," S. H. Harding. The Technical College, Brighton. 6.30 p.m.

I.E.E. (N. Lancs). "Some Considerations in the Application of Power Rectifiers and Convertors," J. P. McBreen. N.W.E.B. Demonstration Theatre, Friargate, Preston. 7.15 p.m.

I.E.E. (N.W. Electronics and Communications Group). "The Ultrasonic Microscope," C. N. Smyth. Engineers' Club, Manchester. 6.15 p.m.

I.E.E. (S. Midlands Graduates and Students). "Colour Television," P. S. Carnt. James Watt Memorial Institute, Birmingham. 6.30 p.m.

Women's Engineering Society (London). "Ground Effect Machines." "Hope House," 45 Great Peter St, Westminster, S.W.1. 7 p.m.

Institution of Mechanical Engineers. "The Design Commissioning and Operation of Blyth 'A' Power Station," A. E. Powell and E. Forth. Birdcage Walk, S.W.1. 6 p.m.

Royal Society of Arts. "Ergonomics—Fitting the Job to the Worker," C. B. Frisby. John Adam St, Adelphi, W.C.2. 6 p.m.

Newport and District Electric Club. "Electricity in the Coal Industry," D. Evans. King's Head Hotel, Newport, Mon. 6.30 p.m.

I.E.S. (Edinburgh). Paper by Chairman of the Centre. Y.M.C.A. Social Room, 14 South St. Andrew St. 6.15 p.m.

I.E.S. (Newcastle). "Modern Films of Lighting," Room B7, The Percy Bldg, King's College, Queen Victoria Rd. 6.15 p.m.

British Institution of Radio Engineers. A.G.M. followed by "Multi-layer Switching Devices," G. F. Taylor. London School of Hygiene and Tropical Medicine, Keppel St, W.C.1. 6 p.m.

British Institution of Radio Engineers (N. Eastern). "The Applications of Photomultipliers in Industry and Research," J. Hambleton. Institution of Mining and Mechanical Engineers, Neville Hall, Westgate Rd, Newcastle upon Tyne. 6 p.m.

British Institution of Radio Engineers (Scottish). "A Survey of Microwave Valves," C. R. Russell. Edinburgh. Repeated on 12 Jan. in Glasgow. 7 p.m.

British Institution of Radio Engineers (S. Wales). "The Measurement of Ionising Radiation," R. G. Wood. Welsh College of Advanced Technology, Cardiff. 6.30 p.m.

British Institution of Radio Engineers (W. Midlands). "Equipment for Automatically Processing Time Multiplexed Telemetry Data," N. Purnell and T. T. Walters. Wolverhampton College of Technology. 6.15 p.m.

A.S.E.E. (Birmingham). "Control Centres for Modern Industry," A. S. Paice. Birmingham Exchange and Engineering Centre, Stephenson Pl. 7.30 p.m.

A.S.E.E. (Luton). "The Development of Motor Control Centres," F. Caesar-Gordon. Luton College of Technology, Park Sq. 8.15 p.m.

THURSDAY, 12 JAN.

I.E.E. (Utilisation Section). "A New Form of Crane-Hoist Control Using a 3:1 Pole-Changing Induction Motor," O. I. Butler and V. Ahmad. Savoy Pl, W.C.2. 5.30 p.m.

I.E.E. (Southern). "Electronic Aids to Banking and Commerce," R. Feinberg. South Dorset Technical College, Weymouth. 6.30 p.m.

I.E.E. (W. Wales). "The Characteristics and Protection of Semiconductor Rectifiers," D. B. Corbyn and N. L. Potter. Conference Room, S. Wales Electricity Board, The Kingsway, Swansea. 6 p.m.

I.E.E. (N. Scotland). "Discrimination Between H.R.C. Fuses," E. Jacks. Electrical Engineering Dept., Queen's College, Dundee. 7 p.m.

S. Wales Institute of Engineers. "The Strain Ageing of Mild Steel," W. J. S. Roberts. Institute Bldgs, Park Pl, Cardiff. 6 p.m.

Society of Instrument Technology (Liverpool). "Load Cells," J. M. Hook. M.A.N.W.E.B. Industrial Development Centre. 7 p.m.

I.E.S. (Manchester). "Chemical Reaction of Light on Colour Film," R. B. Collins. Demonstration Theatre of N.W.E.B., Town Hall Extension. 6 p.m.

FRIDAY, 13 JAN.

I.E.E. (Utilisation Section). Dinner-dance. Café Royal. 7 p.m.

I.E.E. (N. Scotland). "Discrimination Between H.R.C. Fuses," E. Jacks. Robert Gordon's Technical College, Aberdeen. 7.30 p.m.

I.E.E. (N.E. Graduates and Students). "Peltier Effects in Semiconductors," D. E. Clark. Grey Hall, King's College, Newcastle upon Tyne. 6.30 p.m.

E.P.E.A. (Meter Engineers' Technical Group). "Cast Resin Engineering," H. S. Lewis. Caxton Hall, Westminster, S.W.1. 6.30 p.m.

Junior Institution of Engineers. "Xerography and Allied Subjects," W. C. C. Ball. Pepys Hse, 14 Rochester Row, S.W.1. 7 p.m.

Society of Instrument Technology (Midlands). "Controls Associated With Flying," Capt A. M. A. Majendie. Lecture Theatre of the Byng Kendrick Suite at the Gosta Green College of Technology, Aston St, Birmingham. 7 p.m.

I.E.S. (Birmingham). Annual dinner. Queen's Hotel. 7.30 p.m.

MONDAY, 16 JAN.

I.E.E. (Mersey and N. Wales). "The Logmotor—A Cylindrical Brushless Variable-Speed Induction Motor," Prof F. C. Williams, E. R. Laithwaite, J. F. Eastham and L. S. Piggott. Town Hall, Chester. 6.30 p.m.

I.E.E. (S. Midlands). "Magnetic Recording of TV Programmes," H. E. Farrow. B.B.C. Training School, Wood Norton, nr. Evesham. 7.30 p.m.

I.E.E. (N. Staffs). "Some Considerations in the Application of Power Rectifiers and Convertors," J. P. McBreen. Technical College, Stafford. 7 p.m.

I.E.E. (W. Supply Group). "The Shielding of Overhead Lines Against Lightning," J. H. Gridley. Demonstration Theatre, Electricity Hse, Colston Ave, Bristol 1. 6 p.m.

Physical Society Exhibition, Royal Horticultural Halls, until 20 Jan.

GAZETTE ANNOUNCEMENTS

COMPANIES ACTS

Dydeal Ltd. Petition for winding-up to be heard before the High Court of Justice, Strand, W.C.2, on 16 Jan. Persons intending to appear to notify A. E. Samuels and Co., 292 High Holborn, W.C.1, by 1 p.m., 14 Jan.

Ero Condenser Co. Ltd. General meeting of members to be held at 10 Swift St, S.W.6, on 27 Jan., at 8 p.m., to have an account of the winding-up laid before them.

A. W. Holmes (Radio and Electrical Services) Ltd. Meeting of creditors to be held at offices of Radford, McColl and Co., 12 Portland St, Southampton, on 6 Jan., at 2.30 p.m.

A.J.C. Electrics Ltd. First meetings of creditors and contributories to be held at Room 401, Inveresk Hse, 346 Strand, W.C.2, on 10 Jan., at 3.30 and 4 p.m., respectively.

Millmans of Putney Ltd. First meetings of creditors and contributories to be held at Room 401, Inveresk Hse, 346 Strand, W.C.2, on 10 Jan., at 11.30 a.m. and 12 noon, respectively.

S.A.L. Electrical Ltd. First meetings of creditors and contributories to be held at Shire Hall, Gloucester, at 11.30 a.m. and 12 noon, respectively.

BANKRUPTCY ACTS

Receiving Orders

Coventry. D. Roberts and F. J. Webb, domestic appliance retailers, formerly carrying on business as Rowe Electrical Services at 130 Foleshill Rd and Corporation St, Coventry. Receiving order dated 15 Dec.

Croydon. S. N. Folkard, electrical dealer, 183 Lee High Rd, S.E.13. Receiving order dated 19 Dec.

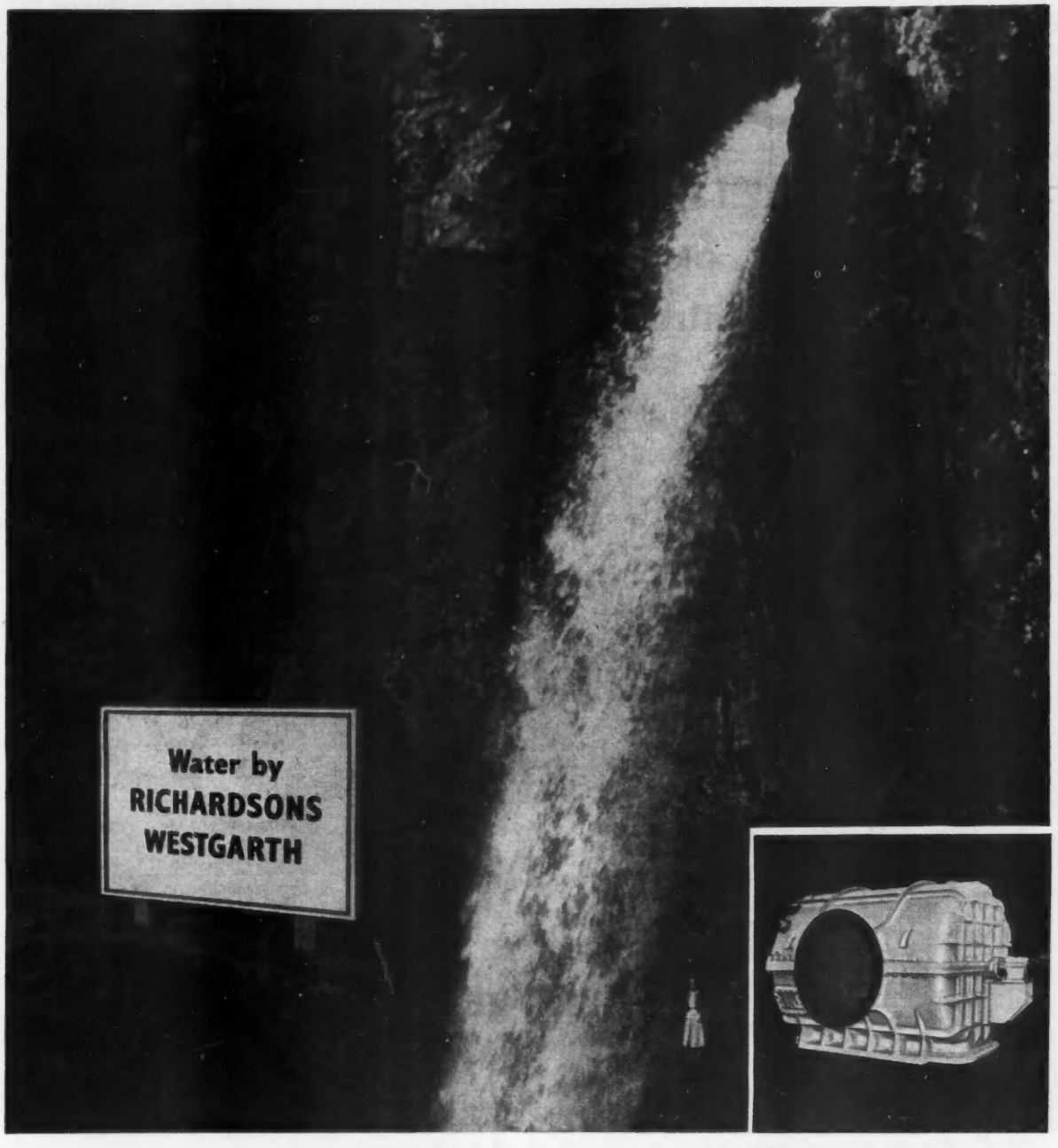
Falmouth. G. M. Hardy and J. F. King, electrical dealers, carrying on business as Hardy and King at Hamilton Hse, The Platt, Wadebridge, Cornwall. Receiving order dated 19 Dec.

Public Examination

High Court of Justice. A. H. Turner, electrical engineer, carrying on business as Light and Shade at 24 Crouch End Hill, N.8. Public examination: 11 a.m., 14 Feb., at Bankruptcy Bldgs, Carey St, W.C.2.

Dividend

Croydon. H. F. Mouncey, electrical engineer, of 4 Cromer Rd, S.W.17. Dividend per £: 2s 3¼d, payable at 58-61 York Terr, Regent's Pk, N.W.1, on 13 Jan.



A single strainer of the type we supply to the C.E.G.B. handles five million gallons of water an hour... enough to maintain quite a spectacular waterfall. At Aberthaw Power Station there are six such units with a total capacity of 30,000,000 g.p.h. straining the condenser cooling water.

Richardsons Westgarth rotary strainers are made in a range of sizes from 160,000 g.p.h. to 5,000,000 g.p.h., they are self cleaning, operate continuously, and the accumulated sludge is blown out at intervals without interrupting the flow. *Please write for illustrated brochure.*

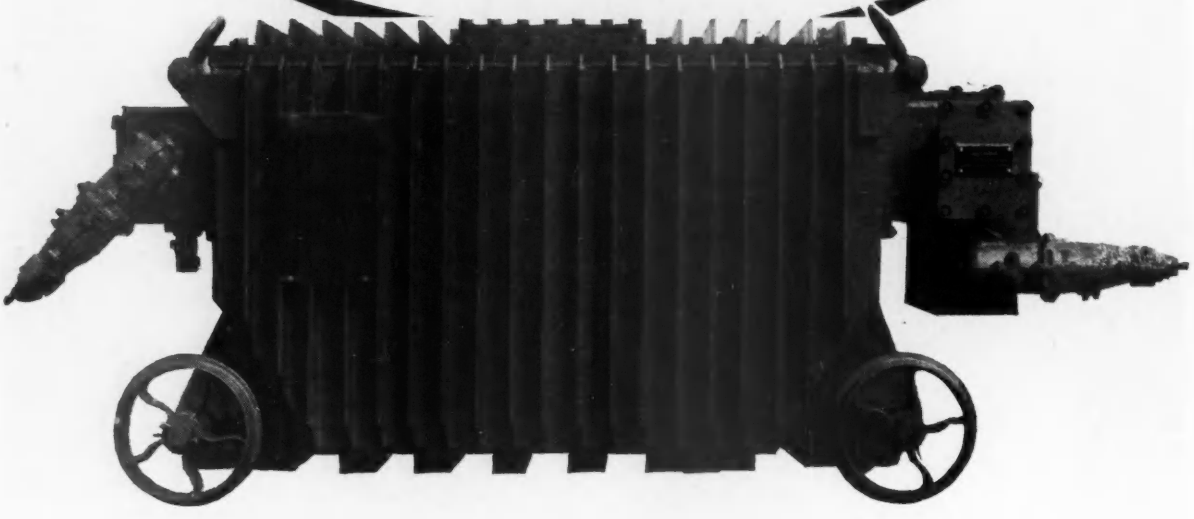
RICHARDSONS WESTGARTH (HARTLEPOOL) LTD.

A member of the RICHARDSONS WESTGARTH GROUP

HARTLEPOOL, CO. DURHAM AND AT 58 VICTORIA STREET, LONDON, S.W.1.
59 MOSLEY STREET, MANCHESTER, 75 BUCHANAN STREET, GLASGOW.

RW 59

AEI flameproof dry-type class C insulated mining transformer



FLP 4474
Group I

150, 200, 250 and 300 kVA

- Class C insulated
- No fire or explosion risk
- Reduced maintenance
- Can be used right at the coal face, reducing low voltage cable run and consequent voltage drop
- Efficient operation in humid and dusty atmospheres
- Standard mining cable arrangements
- Transwitch* (with certified flameproof circuit breaker) also available
- Robust to withstand roof falls
- Adjustable rail clearance
- Suitable for any rail gauge between 18" and 36"
- Unobstructed access to cover-mounted tap changer handhole
- Long and considerable experience in mining transformer manufacture

** Registered Trade Mark*

For further details write to AEI Transformer Division, Southmoor Road, Wythenshawe, Manchester, 23, or to your local AEI Office.

AEI **Associated Electrical Industries Ltd.**
Transformer Division
MANCHESTER AND RUGBY

E/M 001

CLASSIFIED ADVERTISEMENTS

TENDERS INVITED

ELECTRICITY (ESSENTIAL SUPPLIES) ACT (NORTHERN IRELAND) 1954
City and County Borough of Belfast
Electricity Department

TENDERS are invited for the Supply, Delivery and Erection of:

Air Heater Element Cleaning Equipment at Belfast Municipal Electric Power Station West.

Form of Tender (N.2484), Conditions and Specification, in quintuplicate, may be obtained from Messrs Merz and McLellan, Consulting Engineers, Carliol Hse, Newcastle upon Tyne 1, on payment of a deposit of Five Guineas which will be refunded provided a bona fide tender is lodged and not withdrawn. Extra copies of the tender document may be obtained at One Guinea each; this sum will not be returnable. Cheques should be made payable to the Belfast Corporation Electricity Department.

Each tender, in quadruplicate, in sealed envelope marked "Tender for Air Heater Element Cleaning Equipment, Electricity Department" and endorsed with the name and address of the tenderer, must be addressed to the Town Clerk, City Hall, Belfast 1, so as to reach him not later than 4 p.m. on Friday, 3 Feb., 1961.

An official receipt must be obtained for each tender delivered by hand. Tenders sent by post should be registered.

The lowest or any tender will not necessarily be accepted.

C. A. R. SHILLINGTON,
Chairman,
Northern Ireland Joint Electricity Committee.

(T 218)

BOROUGH OF WREXHAM
Street Lighting Fittings

TENDERS are invited for the supply and delivery to the Corporation Depot of the following Street Lighting Fittings:

(a) 130 Cast Iron Columns and Brackets (15 ft mounting height).
(b) 100 Totally Enclosed Lanterns.
(c) 100 Chokes and Capacitors for 80 W Mercury Vapour Lighting.
(d) 100 No. 80 W Colour-corrected Mercury Vapour Lamps.

Forms of Tender for any or all of the above from the Borough Engineer and Surveyor, 31 Chester St, Wrexham.

Completed tenders in the appropriate envelope provided to be returned to the undersigned not later than 12 noon, 6 Feb., 1961.

PHILIP J. WALTERS,
Town Clerk.

Guildhall,
Wrexham.
Dec., 1960. (T 244)

BOROUGH OF EALING
Renewal of Electrical Installation at Stanhope Primary School, Mansell Road, Greenford, Middlesex.

TENDERS are invited from approved N.I.C.E.I.C. contractors for the above-mentioned work. Specification and Tenders from Borough Engineer, Town Hall, Ealing, W.5, on receipt of deposit of £1, returnable on receipt of a bona fide tender.

Closing date: 26 Jan., 1961.

E. J. COPE BROWN,
Town Clerk.

(T 228)

OTLEY URBAN DISTRICT COUNCIL
Installation of Group "A" Lighting

TENDERS are invited for the supply and erection of 95 (ninety-five) plain tubular steel street lighting columns and brackets, totally enclosed side entry lanterns, lamps, ancillary control gear and wiring for 400 watt colour-corrected mercury fluorescent lighting in Otley along 1·8 miles of the Liverpool-Preston-Leeds Trunk Road, A660.

Forms of tender, Specification and Bills of Quantities may be obtained from the office of the Council's Engineer and Surveyor, North Parade, Otley, on payment of a deposit of one guinea which will be refunded on receipt of a bona-fide tender not subsequently withdrawn.

Tenders, in plain sealed envelope endorsed "Group 'A' Lighting," must be delivered to the undersigned not later than 12 noon on Saturday, 28 Jan., 1961.

The Council does not bind itself to accept the lowest or any tender received.

H. HALSTEAD,
Clerk of the Council.

Council Offices,
North Parade,
Otley,
Yorks.
22 Dec., 1960. (T 219)

COUNTY BOROUGH OF SUNDERLAND

TENDERS are invited for Electrical Installation to Humbledon Training Centre. Tender documents obtainable from Borough Architect, Grange Hse, Stockton Rd, Sunderland.

Sealed tenders endorsed "Tender for Electrical Installation—Humbledon Training Centre" must be received at my office, Town Hall, by 21 Jan., 1961.

G. S. McINTIRE,
Town Clerk.

(T 240)

N.A.T.O. COMMON INFRASTRUCTURE SLICE VI
NAVAL BASE INSTALLATIONS

FINAL NOTICE is hereby given that International Competitive Bids will be invited on or about 28 April, 1961, for the following electrical installation work at a Depot to be constructed in the Dunbartonshire area of Scotland.

(a) Installation only of 11 kV switchgear, supply and installation of transformers.
(b) High voltage and medium voltage mains cabling.
(c) Electrical installations in buildings.
(d) Lightning conductor installation.
(e) Cathodic protection.
(f) Street lighting.

2. The approximate cost of the contract is £100,000.

3. The work will be carried out as one contract which will be undertaken as a sub-contract within the framework of the Main Construction Contract.

4. It should be noted that the importation of labour from sources outside the United Kingdom may be subject to restriction and that permission could, in any case, only be given on an undertaking that the contractor would pay rates of wages and observe hours and conditions of labour not less favourable than those established for United Kingdom labour for the trade or industry in the same area.

5. The closing date for receipt of bids will be 28 June, 1961.

6. Firms wishing to bid must formally notify their desire by application to the

continued in next column

continued from previous column

address below by 28 Feb., 1961.

7. Within one week after the closing date for the receipt of applications to bid, firms wishing to be invited must forward the following information:

(i) Statement of financial resources and evidence of financial stability.
(ii) Details of recent contracts for work of a comparable nature including an indication of the value of each.

8. Enquiries regarding bidding should be addressed to:

Director General, Navy Works, Admiralty, Chamberlain Way, Pinner, Middx, England, quoting reference N.A.T.O. C.I. Job No. 3 (Sub-Contract Electrical Installation).

(T 269)

APPOINTMENTS VACANT

CENTRAL ELECTRICITY GENERATING BOARD
East Midlands Division
SHIFT CHARGE ENGINEER
BURTON-ON-TRENT POWER STATION
Vacancy No. 280/60.

APPLICATIONS are invited for the position of Shift Charge Engineer at Burton-on-Trent Power Station, Wetmore Rd, Burton-on-Trent, Staffs.

Sound technical training and practical experience in the control and operation of steam generating plant and main switchgear are required. Appropriate qualifications an advantage.

Salary will be in accordance with Class E, Grade 7 (£965/£1,090 per annum), of the National Joint Board Agreement, plus 10% allowance for shift duties.

Closing date for receipt of applications: 13 Jan., 1961.

PLANT SHIFT CONTROL ENGINEER
DRAKELOW "A" POWER STATION
Vacancy No. 281/60.

Applications are invited for the position of Plant Shift Control Engineer at Drakelow "A" Power Station, near Burton-on-Trent, Staffs.

Experience desirable in control of boilers and turbines at high pressure and temperature, pulverised fuel, together with electrical control room experience. Technical qualifications to Higher National standard desirable.

Salary will be in accordance with Class J, Grade 10 (£1,040/£1,165 per annum), of the National Joint Board Agreement, plus 10% allowance for shift duties.

Closing date for receipt of applications: 13 Jan., 1961.

These appointments will be pensionable within the terms and conditions of the Electricity Supply (Staff) Superannuation Scheme.

Applications should be submitted on the official form AE6/ACT which may be obtained from the Station Superintendent concerned and should be returned to him by the date stated.

O. S. WOODS,
Divisional Controller.

(T 260)

CENTRAL ELECTRICITY GENERATING BOARD
Midlands Division
ASSISTANT SHIFT CHARGE ENGINEER

REQUIRED at Ironbridge Power Station. N.J.B. service conditions, superannuable appointment, salary within Schedule A, Grade J.9, £1,115/£1,245 per annum, plus 10% shift duties.

A sound technical training and practical power station experience are required, in the operation of steam generating plant and main switchgear. Appropriate technical qualifications an advantage.

Apply, quoting vacancy number 345/60MD on form AE6, which are available from the Station Superintendent, Ironbridge Power Station, Buildwas, Salop, to be completed and returned not later than 16 Jan., 1961.

F. W. SKELCHER,
Divisional Controller.

(T 265)

Advertisements should be sent to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London, W.C.2, before 10 a.m. on TUESDAY of the week of issue. Official Displayed Advertisements are charged at 46s. per inch, and all other classified advertisements at 3s. 6d. per line. Situations Wanted four insertions at twice the single insertion rate. Fee for Box Number and postage on replies 2s.

EASTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments. The successful candidates will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

Essex Sub-Area

CHELMSFORD DISTRICT

THIRD AND FOURTH ASSISTANT ENGINEERS

Candidates should have had a sound technical training and suitable experience in the construction, operation and maintenance of H.V. and L.V. overhead and underground distribution systems including substations.

Salary: Third Assistant: N.J.B. Class F, Grade 9 £890/£1,015.

335/60.R.

Fourth Assistant N.J.B. Class F, Grade 11 (£765/£870).

336/60.R.

Apply by letter to D. H. Walker, A.M.I.E.E., Manager, Eastern Electricity Board, Anchor St, Chelmsford, Essex, by 13 Jan., 1961.

Norfolk Sub-Area

SUB-AREA HEADQUARTERS

THIRD ASSISTANT ENGINEER (MOBILE)

337/60.N.

The successful applicant will be based in the Sub-Area Engineer's Department at Norwich, but will be required to operate anywhere within the Norfolk Sub-Area as required.

Candidates should have had a sound technical training and experience in the planning, construction, operation and maintenance of overhead and underground distribution systems, including substations.

Salary: N.J.B. Class K, Grade 10 (£1,115/£1,245).

Apply by letter to the Manager, Norfolk Sub-Area, Eastern Electricity Board, 4 Duke St, Norwich, by 13 Jan., 1961.

Northmet Sub-Area

ST. ALBANS DISTRICT

SENIOR SALES REPRESENTATIVES (FOUR POSTS)

(Ref.: 828, 919 and 973)

338/60.R.

Candidates must have had a sound practical training, with experience in electrical installation work for domestic and commercial premises. A good knowledge of electrical water heating and ability to prepare wiring specifications and estimates is required with an all-round knowledge of, and an ability to sell, domestic electric appliances.

Salary: N.J.C. Grade 2 (£700/£775).

Apply by letter to F. J. Drake, ASSOCIATE I.E.E., Manager, Eastern Electricity Board, 107 St. Peter's St, St. Albans, by 13 Jan., 1961. (T 242)

SIERRA LEONE

Electricity Department

COMMERCIAL ENGINEER (ELECTRICAL)

QUALIFICATIONS: Candidates (aged 30-45), must be A.M.I.E.E. with experience in budgeting, control of revenue and expenditure and forecasting of expenditure and capital requirements.

Duties: To be responsible for implementation of tariffs negotiations and preparation of special agreements, sales control of stores policy, investigation and preparation of cost analysis and all activities of a commercial nature associated with the sale of electricity.

Terms of appointment: On contract for three tours of 18-24 months in salary scale £2,300//£2,450 with 15% gratuity. Outfit allowance. Children's allowance. Free passages. Quarters normally available at low rental. Generous leave.

Write to Director of Recruitment, Colonial Office, London S.W.1, giving full names, age, qualifications and experience, quoting BCD 145/15/08/D10.

(T 231)

CENTRAL ELECTRICITY GENERATING BOARD

London Division

APPLICATIONS are invited for the following superannuable posts. Conditions of service in accordance with N.J.B. Agreement, Schedule A and B. Salary includes London Allowance.

FOURTH ASSISTANT ENGINEER (DEVELOPMENT)
ELECTRICAL DEPARTMENT
DEVELOPMENT SECTION
DIVISIONAL HEADQUARTERS
GENERATION HOUSE
Vacancy No. 60/1011.

Candidates should possess academic qualifications equivalent to corporate membership of the Institution of Electrical Engineers. Familiarity with methods of solving short circuit power flow problems on high voltage transmission systems will be an advantage. Salary: Class BX, Grade 11 =From 1 July, 1960, £905/£1,215 per annum, from 1 July, 1961, £950/£1,215 per annum.

THIRD ASSISTANT ENGINEER (TELECOMMUNICATIONS)
ELECTRICAL DEPARTMENT
DIVISIONAL HEADQUARTERS
LOCATED AT
NATIONAL CONTROL CENTRE
BANKSIDE HOUSE
LONDON, S.E.1
Vacancy No. 60/1012.

Applicants should possess a Higher National Certificate or equivalent qualification and should have had considerable experience of the installation, testing and maintenance of telecommunication equipment such as automatic telephony, line signalling and telemetering systems. A knowledge of the Generating Board's Standardised Central Indicating System would be an advantage. Salary: Class BX, Grade 8= From 1 July, 1960, £1,155/£1,460 per annum, from 1 July, 1961, £1,195/£1,460 per annum.

ASSISTANT STATION CHEMIST
BLACKWALL POINT POWER STATION
Vacancy No. 60/1013.

Candidates should preferably hold H.N.C. (Chem.) and have had experience in analysis of coal, oil and water, together with other chemical duties required in a power station. Salary: Class G, Grade 9=£1,015/£1,140 per annum.

Applications, quoting vacancy number to (or on form from) Personnel Officer, Central Electricity Generating Board, London Division, P.O. Box 136, London, W.1, by 17 Jan., 1961. (T 227)

YORKSHIRE ELECTRICITY BOARD

No. 3 (Sheffield) Sub-Area

GENERAL ASSISTANT ENGINEER (METERS, TESTING AND PROTECTION)

APPLICANTS should have had a good all round training in Electrical Engineering. Possession of the Higher National Certificate in Electrical Engineering is desirable.

Salary: N.J.B. Class N, Grade 16 (Scale 6), £890/£1,015 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 3 (Sheffield) Sub-Area, Yorkshire Electricity Board, Commercial St, Sheffield, not later than 13 Jan., 1961.

No. 7 (Grimsby) Sub-Area

ENGINEERING DRAUGHTSMAN

Applications are invited for the post of Draughtsman (either Electrical or Building and Civil Engineering) in the Sub-Area Drawing Office. The successful applicant will be required to assist in the Drawing Office on work which includes building drawings, electrical diagrams and records.

Salary: N.J.B. either Class K, Grade 16 (Scale 3), £715/£805 per annum; or Class K, Grade 15 (Scale 4), £765/£870 per annum, according to qualifications.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 7 (Grimsby) Sub-Area, Yorkshire Electricity Board, Moss Rd, Grimsby, not later than 13 Jan., 1961. (T 214)

CENTRAL ELECTRICITY GENERATING BOARD

South Wales Division

APPLICATIONS invited for the following superannuable N.J.B. appointments in the South Wales Division:

ASSISTANT SHIFT CHARGE ENGINEER
TIR JOHN POWER STATION, SWANSEA
VACANCY No. 330/ET/60.

Salary: Class H, Grade 9, Scale 8 (£1,040/£1,165 per annum), plus 10% shift enhancement).

ASSISTANT SHIFT CHARGE ENGINEER
UPPER BOAT POWER STATION
NR. PONTYPRIDD, GLAM
VACANCY No. 331/ET/60.
Re-Advertisement.

Salary: Class H, Grade 9, Scale 8 (£1,040/£1,165 per annum), plus 10% shift enhancement).

Previous applicants need not reapply.

STATION SHIFT CONTROL ENGINEER
ABERTHAW POWER STATION
THE LEYS, NR. BARRY, GLAM
VACANCY No. 332/ET/60.

Salary: Class L, Grade 10, Scale 10 (£1,190/£1,325 per annum), plus 10% shift enhancement).

Applicants should possess H.N.C. or equivalent qualifications and have had operating experience in a modern power station.

FOURTH ASSISTANT ENGINEER
TECHNICAL DEPARTMENT
DIVISIONAL HEADQUARTERS, CARDIFF
VACANCY No. 333/ET/60.

Salary: Class A, Grade 11, Scale 7 (£855, £1,090 per annum).

Applicants should have served an engineering apprenticeship, and should preferably have had subsequent experience with a large electrical manufacturing firm, or in the Electricity Supply Industry.

The successful applicant will be employed on interesting problems in generating stations and on the 132 kV grid.

Applicants should possess an electrical engineering degree or H.N.C.

Special application forms are obtainable from Secretary, South Wales Division, Central Electricity Generating Board, Twyn-y-fedwen Rd, Gabalfa, Cardiff, to be returned by 14 Jan., 1961. (T 220)

MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable posts:

South Staffs and North Worcs Sub-Area

GENERAL ASSISTANT DISTRICT ENGINEER (SMETHWICK/WEST BROMWICH)

Applicants should have suitable technical qualifications and training in engineering duties associated with electricity distribution systems. Salary: £965/£1,090 per annum (N.J.B. Grade K.12). Apply, by letter, within ten days, stating age, experience, present position and salary to Mr H. A. P. Caddell, Sub-Area Manager (Ref. EMI/SEC), Midlands Electricity Board, P.O. Box No. 9, Toll End Rd, Tipton, Staffs.

Worcester and District Sub-Area

THIRD ASSISTANT DISTRICT ENGINEER (REDDITCH/BROMSGROVE)

Duties involve the construction, maintenance and operation of H.V. and L.V. distribution systems. Technical qualifications desirable. Salary: £965/£1,090 per annum (N.J.B. Grade G.9). Apply, by letter, within 14 days, stating age, qualifications, experience, present position and salary to Mr E. B. Willis, District Manager, Midlands Electricity Board, Windsor Rd, Redditch, Worcs.

F. W. CATER,
Secretary.
(T 230)

Box No. replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London, W.C.2

AIR MINISTRY

require

ASSISTANT MECHANICAL AND ELECTRICAL ENGINEERS

FOR design construction and maintenance of installation on airfields, radar stations, missile bases, workshops and maintenance units for the R.A.F. at home and overseas as well as certain Civil Airports. Salary: £805 at 25 to £1,095 at 34 or over, thereafter rising to max. £1,260 with increase for London and slight decrease for country districts. Appointments long term with promotion and pension prospects. Five-day week with four weeks' two days' leave a year initially. Special allowances payable in addition to salary during overseas service.

Minimum qualifications and experience:

(i) (a) University degree or equiv. diploma in electrical and/or mechanical engineering with at least two years' apprenticeship; or

(b) Graduate or corporate member of I.E.E. with at least three years' apprenticeship; or

(c) Graduate or corporate member of I.Mech.E. appreciable electrical engineering experience with at least three years' apprenticeship; and

(ii) Have been employed for minimum of two years with well established engineering concern and gained wide experience in both electrical and mechanical engineering practice.

Applicants must be natural born British subjects between ages of 25 and 45. Forms from Ministry of Labour, Technical and Scientific Register (K), 26 King St, London S.W.1, quoting D.158/0A. (T 16)

GOVERNMENT OF ADEN

Public Works Department

ELECTRICAL AND MECHANICAL ENGINEER

QUALIFICATIONS: Candidates must be A.M.I.Mech.E. or A.M.I.E.E. with ten years' extensive experience in Electrical and Mechanical Engineering.

Duties: To take charge of the Electrical and Mechanical branches of the Department and to advise the Director of Public Works on technical matters in those spheres.

Terms of appointment: Contract for 18-24 months. Salary at appropriate point in scale £1,232/£2,004. Gratuity. Children's allowances. Free passages. Outfit allowance. Married quarters available at moderate rental. Generous home leave.

Write Director of Recruitment, Colonial Office, London S.W.1, giving full names, age, qualifications and experience, quoting BCD 112/2/018/D10. (T 223)

AIR MINISTRY

Works Designs Branch

REQUIRES in London and Provinces ENGINEERING DESIGNER DRAUGHTSMEN

experienced in preparation of schemes for illumination and electrical equipment of buildings or schemes for H.V. and M.V. electrical distribution. Candidates should have served recognised apprenticeship or had equiv. training and also have had practical exp. O.N.C. an advantage. Financial assistance and time off for recognised courses of study. Promotion and pension prospects. Five-day week with 18 days' paid leave per year initially. Overseas tours for which special allowances granted.

Salary: in London ranges from £805 (age 25) to £980 p.a., somewhat lower in Provinces. Commencing salary dependent on age, quals. and exp. Applicants, who must be natural born British subjects, should write quoting O/N King's Cross 4354 to Air Ministry, W.G.d, Theobalds Rd. London W.C.1 or to any Employment Exchange, giving age, details of training, quals., full particulars of former posts held and copies of any testimonials. Candidates selected will normally be interviewed in London and certain expenses reimbursed. (T 82)

MIDLANDS ELECTRICITY BOARD

Wolverhampton & District Sub-Area

MAINS FOREMAN (WOLVERHAMPTON)

DUTIES will include control and supervision of cable laying staff and co-ordination of transport arrangements. Experience in control of a large manual labour force necessary. Conditions of service and salary—£880 per annum, Schedule E, Grade 1—in accordance with N.J.I.C. Agreement. Apply, by letter, within seven days, to District Manager, Midlands Electricity Board, 83 Darlington St, Wolverhampton.

F. W. CATER,
Secretary.
(T 229)

KENYA GOVERNMENT

ELECTRICAL TECHNICIANS

TECHNICAL ASSISTANTS GRADE II (ELECTRICAL)

REQUIRED for one tour of 36-45 months in first instance. Salary according to age and experience in scale (including Inducement Pay) rising to £1,173 a year. Gratuity 13½% of total salary drawn. Outfit allowance £40. Free passages. Liberal leave on full salary. There is a Salary Commissioner at present in East Africa and an increase in salary is likely.

Candidates under 45 years of age must have served full apprenticeship and have had subsequent experience of wiring, cable jointing, overhead line work and general maintenance. They must be capable of installation and supervision of electrical work on building projects and able to instruct junior staff. Apply to Crown Agents, 4 Millbank, London S.W.1, for application form and further particulars, stating age, name, brief details of qualifications and experience and quoting reference M2A/51133/EE. (T 222)

CENTRAL ELECTRICITY GENERATING BOARD

North Eastern and Yorkshire Region

SECOND ASSISTANT STATION CHEMIST DONCASTER "B" POWER STATION

APPLICATIONS are invited for the appointment of Second Assistant Station Chemist at Doncaster "B" Power Station.

Applicants should preferably hold Higher National Certificate in Chemistry and have had previous Power Station experience. A knowledge of the operation of modern water treatment plants would be considered advantageous.

The conditions of service and salary will be in accordance with the National Joint Board Agreement, Grade 11, Class G, Schedule A (£825/£940 per annum).

Form of application may be obtained from any office of the Board or from the Assistant Regional Secretary (Personnel), Central Electricity Generating Board, North Eastern and Yorkshire Region, 1 Whitehall Rd, Leeds 1, to whom they should be returned to arrive not later than 7 Jan., 1961. (T 207)

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

SERVICE CENTRE ASSISTANT

REQUIRED at Johnstown, near Wrexham.

Salary within the range £225/£640 per annum, according to age, experience and educational qualifications.

Applicants should preferably have had experience in the electrical retail trade, or similar sales experience.

Appointment subject to medical examination. Pension Scheme.

Standard application forms obtainable from the Manager, No. 4 Sub-Area, Rhostyllen, near Wrexham, or from any District Office.

Closing date: 11 Jan., 1961. (T 225)

TRINIDAD AND TOBAGO ELECTRICITY COMMISSION

VACANCY—ASSISTANT ENGINEER (STANDARDS AND DEVELOPMENT)

THE Trinidad and Tobago Electricity Commission has a vacancy for an Assistant Engineer (Standards and Development) in its Distribution Division at Head Office.

Applicants must hold a Degree or the Higher National Certificate in Electrical Engineering or be Graduate Members of the Institution of Electrical Engineers.

The annual salary is £1,470 rising to £1,590 in accordance with Grade 6D of the Commission's Salary Schedule. A car allowance is also paid for necessary journeys undertaken on Commission's business.

The successful applicant will be responsible to the Design Engineer mainly for the preparation of standards for methods of construction and of materials used in the Distribution Division and also for the preparation of specifications and checking of tenders in connection with orders for distribution material and equipment.

An outfit allowance of £60 is also paid on arrival in Trinidad.

A partly furnished house will be provided at a rent of £10 8s 4d per month, plus a small extra charge for heavy furniture.

First class passages to Trinidad will be provided for the successful applicant, his wife and children up to a maximum cost of four adult passages. First class leave passages to the United Kingdom will be provided every three years.

Information on Trinidad can be obtained from the West India Committee, 40 Norfolk St, London W.C.2.

There is a Superannuation Scheme similar to the C.E.G.B. and Area Board's Scheme.

Applications giving full details of qualifications, age, experience, etc., together with copies of two recent testimonials should be sent by air mail to reach the General Manager, Trinidad and Tobago Electricity Commission, P.O. Box 121, Port-of-Spain, Trinidad, West Indies, by 15 Feb., 1961. (T 267)

SOUTH OF SCOTLAND ELECTRICITY BOARD

Lanarkshire Area

APPOINTMENT OF FOURTH ASSISTANT ENGINEER—TELECOMMUNICATIONS (TESTING STATION, WATSON STREET MOTHERWELL)

APPLICATIONS are invited from suitably qualified engineers having experience in the installation and maintenance of automatic telephone exchanges and allied equipment, and installation, repair and maintenance of mobile V.H.F. Radio Installations.

The salary and conditions of service relative to this appointment will be in accordance with the National Joint Board Agreement. The present Classification, Grading and Salary will be L.13, Salary Scale 7, £965/£1,090 per annum. The successful candidate will require to reside within a reasonable distance of the Testing Station, Watson St, Motherwell.

Application forms, which may be had from the undersigned, should be returned to this office within 14 days of this notice.

R. J. RENNIE,
Manager.

Montrose Cres,
Hamilton. (T 252)

THE NORTH EASTERN ELECTRICITY BOARD

York Sub-Area

APPLICATIONS are invited for the appointment of a

THIRD ASSISTANT ENGINEER SUB-AREA COMMERCIAL OFFICER'S STAFF

with location at Sub-Area Headquarters, York.

Salary: Schedule A, Class H, Grade 10, £965/£1,090 per annum. N.J.B. conditions of service.

Applications stating age, qualifications and experience to be received by Assistant Secretary (Establishments), The North Eastern Electricity Board, G.P.O. Box No. 117, Carliol Hse, Newcastle upon Tyne 1, within ten days of the appearance of this advertisement. (T 257)

SOUTHERN ELECTRICITY BOARD

ASSISTANT ENGINEER (STANDARDISATION)

SOUTHAMPTON District of No. 4 (Bournemouth) Sub-Area. Salary: N.J.B. Class H, Grade 6 (£1,275/£1,410 per annum). N.J.B. Conditions of Service.

The duties of the post will include responsibility to the District Commercial Engineer for the planning, organisation and supervision of the work involved on consumers' installations and apparatus of approximately 3,000 D.C. and 42,000 non-standard A.C. consumers in the Southampton District, who are to be transferred to standard voltage A.C. supply. Wide experience in installation practice and apparatus conversion is essential. Experience on changeover work and the possession of suitable technical qualifications will be advantages.

Applications on forms obtainable from the Sub-Area Secretary, 1 Priory Rd, Bournemouth, and returned to him, quoting Z.1301, not later than 16 Jan., 1961.

ASSISTANT ENGINEER (STANDARDISATION)

Southampton District of No. 4 (Bournemouth) Sub-Area. Salary: N.J.B. Class H, Grade 9 (£1,040/£1,165 per annum). N.J.B. Conditions of Service.

The duties of the post will include working under the Grade 6 Assistant Engineer (Standardisation) who will be responsible to the District Commercial Engineer for the planning, organisation and supervision of the work involved on consumers' installations and apparatus of approximately 3,000 D.C. and 42,000 non-standard A.C. consumers in the Southampton District, who are to be transferred to standard voltage A.C. supply. Wide experience in installation practice and apparatus conversion is essential. Experience on changeover work and the possession of suitable technical qualifications will be advantages.

Applications on forms obtainable from the Sub-Area Secretary, 1 Priory Rd, Bournemouth, and returned to him, quoting Z.1302, not later than 16 Jan., 1961.

ASSISTANT ENGINEER
(MAINTENANCE AND OPERATION)

Melksham District of No. 2 (Newbury) Sub-Area. Salary: N.J.B. Class G, Grade 9 £965/£1,090 per annum). N.J.B. Conditions of Service.

The duties of the post will be to assist with the maintenance and operation of H.V. and L.V. distribution mains and substations and with minor construction work. A technical training to H.N.C. standard and experience of similar work are required.

Applications on forms obtainable from the Sub-Area Secretary, 7 Oxford Rd, Newbury, Berks, and returned to him, quoting Z.1291, not later than 16 Jan., 1961.

INSTALLATION ASSISTANT

Uxbridge District of No. 1 (Southall) Sub-Area. Salary: N.J.B. Class G, Grade 11 (£825/£940 per annum, plus London Allowance). N.J.B. Conditions of Service.

Applicants should have had experience in the preparation of specifications and estimates for all types of electrical installations, and should be competent to supervise electricians and organise the allocation of work.

Applications on forms obtainable from the Sub-Area Secretary, 2-6 Windmill La, Southall, Middx, and returned to him, quoting Z.1300, not later than 16 Jan., 1961.

SURVEYOR

Yeovil District of No. 4 (Bournemouth) Sub-Area. Salary: N.J.C. 2 (£700/£775 per annum). N.J.C. Conditions of Service.

A sound knowledge and experience of general survey work with ability to peg overhead lines and prepare profiles and plans from surveyed elevations are required.

Applications on forms obtainable from the Sub-Area Secretary, 1 Priory Rd, Bournemouth, and returned to him, quoting Z.1284, not later than 16 Jan., 1961.

DEMONSTRATOR

Yeovil District of No. 4 (Bournemouth) Sub-Area, located at Shaftesbury. Salary: N.J.C. Grade 1 (£600/£700 per annum). N.J.C. Conditions of Service.

Applicants should be qualified to advise generally on the utilisation of electric domestic appliances, to give public demonstrations of apparatus and to assist in showroom duties. The possession of an

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E.A.W. Certificate or equivalent Domestic Science qualification would be an advantage.

Applications on forms obtainable from the Sub-Area Secretary, 1 Priory Rd, Bournemouth, and returned to him, quoting Z.1285, not later than 16 Jan., 1961.

The successful candidates for the above appointments will be required to contribute to the Electricity Supply (Staff) Superannuation Scheme, if eligible. (T 250)

EASTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments. The successful candidates will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

Chilterns Sub-Area

(a) THIRD ASSISTANT ENGINEER
BEDFORD DISTRICT
344/60.N.

(b) THIRD ASSISTANT ENGINEER
HEMEL HEMPSTEAD DISTRICT
345/60.R.

(c) SECOND ASSISTANT ENGINEER
AYLESBURY DISTRICT
342/60.R.

Candidates should have had a sound technical training and considerable experience in the construction, operation and maintenance of H.V. and L.V. overhead and underground distribution systems including substations.

Salary: (a) N.J.B. Class G, Grade 9 (£965/£1,090); (b) N.J.B. Class F, Grade 9 (£890/£1,015); (c) N.J.B. Class F, Grade 7 (£1,040/£1,165).

Apply by letter by 20 Jan., 1961, as follows: (a) The Manager, Bedford District, Eastern Electricity Board, Prebend St, Bedford. (b) The Manager, Hemel Hempstead District, Eastern Electricity Board, Bridge St, Hemel Hempstead, Herts. (c) The Manager, Aylesbury District, Eastern Electricity Board, Exchange St, Aylesbury.

Northmet Sub-Area

THIRD ASSISTANT ENGINEER
HORNSEY DISTRICT
(Ref. 1026) 343/60.R.

Candidates should have had a sound technical training and suitable experience in the construction, operation and maintenance of H.V. and L.V. distribution systems including substations.

Salary: N.J.B. Class G, Grade 9 (£965/£1,090), plus London Allowance.

Apply by letter to C. Bradley, M.I.E.E., Manager, Eastern Electricity Board, The Broadway, Crouch End, London N.8, by 20 Jan., 1961.

Suffolk Sub-Area

FOURTH ASSISTANT ENGINEER
(PLANNING AND DEVELOPMENT SECTION)
SUB-AREA HEADQUARTERS
341/60.N.

The duties of the post are mainly field planning and assistance with the design of L.V. and H.V. systems. Candidates should have had a sound technical training and experience in the construction and operation of urban and rural distribution networks, at voltages up to 33 kV.

Candidates should preferably have obtained the Higher National Certificate in Electrical Engineering or its equivalent.

The successful candidate will be required to reside within reasonable proximity to Stowmarket.

Salary: N.J.B. Class K, Grade 13 (£890/£1,015).

Apply, by letter, to the Manager, Suffolk Sub-Area, Eastern Electricity Board, Finborough Hall, Stowmarket, Suffolk, by 20 Jan., 1961.

THIRD ASSISTANT ENGINEER
CLACTON DISTRICT
346/60.N.

Candidates should have had a sound technical training and suitable experience in the construction, operation and maintenance of H.V. and L.V. overhead and underground systems, including substations, at voltages up to and including 33 kV.

Salary: N.J.B. Class E, Grade 9 (£825/£940).

Apply by letter to S. N. Boyne, A.M.I.E.E., Manager, Clacton District, Eastern Electricity Board, 56-58 Station Rd, Clacton-on-Sea, Essex, by 20 Jan., 1961. (T 271)

YORKSHIRE ELECTRICITY BOARD

No. 3 (Sheffield) Sub-Area

ROTHERHAM AND MEXBOROUGH
DISTRICT
ASSISTANT CONSUMERS' ENGINEER

APPLICANTS should possess a Higher National Certificate in Electrical Engineering or equivalent qualification.

Candidates should be capable of carrying out negotiations with consumers for new and additional supplies and have a sound knowledge of tariffs and their appropriate applications. They should have had experience of general load development, be fully conversant with the wiring rules and regulations of the I.E.E. and be capable of controlling staff and workpeople.

Salary: N.J.B. Class K, Grade 10 (Scale 9), £1,115/£1,245 per annum).

Applications, together with the names of two referees, should be sent to the Manager, Yorkshire Electricity Board, No. 3 (Sheffield) Sub-Area, Commercial St, Sheffield 1, not later than 20 Jan., 1961.

Head Office

ASSISTANT ENGINEER
COMMERCIAL DEPARTMENT

An Assistant Engineer is required in the Development Section of the Commercial Department to assist with technical sales matters. Applicants should be capable of writing technical reports, helping with matters needing a knowledge of I.E.E. and Statutory Regulations concerning electrical installations. They should have a knowledge of British Standards, Codes of Practice and safety regulations. The possession of a recognised electrical qualification would be an advantage.

Salary: N.J.B. Class BX, Grade 11, £855/£990 (transitional), to Scale 8, £1,040/£1,165 per annum.

Applications, together with the names of two referees, should be sent to the Secretary, Yorkshire Electricity Board, Wetherby Rd, Scarcroft, Leeds, not later than 20 Jan., 1961.

No. 7 (Grimsby) Sub-Area

GAINSBOROUGH DISTRICT
SECOND ASSISTANT DISTRICT ENGINEER

Applicants should preferably be Corporate Members of the Institution of Electrical Engineers, or hold an equivalent qualification. They must have had a sound training and extensive experience in the design, construction, operation and maintenance of H.V. and L.V. overhead and underground distribution systems in rural and urban areas, substation plant and ancillary equipment.

Salary: N.J.B. Class E, Grade 7 (Scale 7), £965 x £25—£1,090 per annum.

Applications, together with the names of two refereees, should be sent to the Manager, Yorkshire Electricity Board, No. 7 (Grimsby) Sub-Area, Moss Rd, Grimsby, not later than 20 Jan., 1961. (T 258)

CENTRAL ELECTRICITY GENERATING BOARD

South Wales Division

APPLICATIONS invited for the following superannuable N.J.B. Schedule A appointments of

STATION SHIFT CONTROL ENGINEER
in the South Wales Division:

CARMARTHEN BAY POWER STATION
BURRY PORT, CARMS
Vacancy No. 334/ET/60.

Salary: Class K, Grade 10, Scale 9, £1,115/£1,245 per annum, plus 10% shift enhancement.

UPPER BOAT POWER STATION
NEAR PONTYPRIDD, GLAM
Vacancy No. 335/ET/60.

Salary: Class H, Grade 10, Scale 7, £965/£1,090 per annum, plus 10% shift enhancement.

Applicants should possess H.N.C. or equivalent qualifications, and have had operating experience in a modern Power Station.

Special application forms obtainable from Secretary, South Wales Division, Central Electricity Generating Board, Twyn-y-fedwen Rd, Gabalfa, Cardiff, to be returned by 21 Jan., 1961. (T 245)

LONDON ELECTRICITY BOARD

GENERAL ASSISTANT ENGINEER

APPLICATIONS are invited for the above position. Initially, the successful candidate will be located at 154 Uxbridge Rd, Shepherds Bush, W.12.

Applicants should have a sound technical education to the standard of the Higher National Certificate, and have completed a recognised period of training in the Electricity Industry, or have equivalent experience.

Pending determination as to the grading and salary applicable to the post within the National Joint Board Agreement, the provisional minimum salary will be £685 per annum, rising to £855 per annum inclusive of London Allowance.

Applications should be sent direct to the Manager, Western District, at the above address, within 14 days of the publication date of this notice. Please quote ref.: PER/V/3109/T. (T 248)

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

CONSUMERS ENGINEER

REQUIRED in the Anglesey District based on Holyhead.

Salary within range £890/£1,015 per annum (N.J.B. E/8).

Applicants must have had a sound technical training, and experience within the industry in dealing with:

(a) designing and estimating for all types of electrical installation work;

(b) advising consumers on tariffs, appliances and all aspects of electricity utilisation;

(c) organisation of Service Centres and exhibitions;

(d) control of manual and administrative staff.

Appointment subject to medical examination. Pension Scheme.

Application forms obtainable from the Manager, No. 4 Sub-Area, Electricity Hse, Rhostyllen, nr. Wrexham. Closing date: 20 Jan., 1961. (T 234)

THE NORTH WESTERN ELECTRICITY BOARD

SENIOR ASSISTANT
(SALES SUPERINTENDENT)
NORTH DISTRICT, SALFORD

APPLICANTS should be experienced in the supervision of Service Centres, organisation of exhibitions, demonstrations and displays. The successful candidate will be responsible for domestic and commercial development, and the supervision of staff engaged on that work. Ability to develop business is essential.

Salary Scale: £1,150 x £30—£1,240 p.a. Grade 6. N.J.C. Conditions.

Applications on forms to be obtained from the Manager (Staff Vacancy), No. 1 Sub-Area, The North Western Electricity Board, Town Hall, Manchester 2, P.O. Box 493, and returned to him by 16 Jan., 1961. (T 259)

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

ASSISTANT CONSUMERS' ENGINEER

REQUIRED at Towyn, in the Aberystwyth District. Salary within range £715/£805 per annum (N.J.B. E/11).

Applicants should have completed a recognised electrical apprenticeship, and had some technical training. Duties will include estimating, preparation of specifications and supervision of contracting work, advising consumers on matters relating to electricity supply and the utilisation of electricity. The ability to speak Welsh and to drive would be an advantage.

The work is of an interesting nature, and the post is pensionable, with good working conditions and reasonable future prospects to suitable staff.

Application forms obtainable from the Manager, No. 4 Sub-Area, Electricity Hse, Rhostyllen, nr. Wrexham. Closing date: 13 Jan., 1961. (Applications in response to previous advertisement remain under consideration.) (T 226)

THE NORTH WESTERN ELECTRICITY BOARD

DISTRICT COMMERCIAL ENGINEER
MACCLESFIELD DISTRICT

DUTIES will include the organisation and control of commercial staff and functions in the District which is mainly residential and rural with some light industry; supply of information and advice to consumers on all commercial matters; control of Contracting Section, Service Centres and exhibitions. Corporate Membership of the Institution of Electrical Engineers will be an advantage.

Salary Scale: £1,650/£1,830 p.a. Grade H.2. N.J.B. Conditions.

Applications must be made on a form to be obtained from the Manager, No. 3 Sub-Area, The North Western Electricity Board, Union St, Oldham, and returned to him so as to be received not later than 21 Jan., 1961. (T 232)

LONDON ELECTRICITY BOARD

ASSISTANT DISTRIBUTION ENGINEER

APPLICATIONS are invited for the above position in the Board's Surrey Suburban District at Electricity Hse, Durnsford Rd, Wimbledon, S.W.19.

Applicants should have a sound technical education to the standard of the Higher National Certificate and possess practical experience of engineering work associated with the organisation of a District distribution department.

The post is graded under Schedule A of the National Joint Board Agreement as Class H, Grade 12, £875 per annum, rising to £990 per annum, inclusive of London Allowance.

Applications should be sent direct to the Manager at the above address within 14 days of the publication date of this notice, quoting ref.: PER/V/3178/T. (T 247)

ENGLISH ELECTRIC
ELECTRICAL ENGINEERS

required for the design of light and heavy current electrical/electronic gear on long term experimental projects related to the development of Nuclear Power Reactors.

The work calls for a good theoretical and practical background of all branches of Electrical Engineering. Two of these appointments require experience of closed loop automatic control systems and all computer facilities are available for this work.

Please write giving brief details of qualifications, experience and present salary to the Technical Personnel Officer, Room 534, English Electric Hse, Strand, London W.C.2, quoting reference ET1818E.

(T 233)

CENTRAL ELECTRICITY GENERATING BOARD

Midlands Division

ASSISTANT ENGINEERS
(DIVISIONAL HEADQUARTERS)
PROTECTIVE GEAR SECTION

FOURTH Assistant Engineers are required in the Protective Gear Section of the Electrical Department.

N.J.B. Agreement conditions, superannuable appointment, salary within Schedule B, Class BX, either Grade 9, 10 or 11, according to qualifications and experience. The salary ranges are as follows:

Grade 9: £1,005/£1,325 per annum.
Grade 10: £935/£1,245 per annum.
Grade 11: £855/£1,165 per annum.

Candidates should possess a University Degree, Higher National Certificate in Electrical Engineering or an equivalent qualification and should preferably have some knowledge of protective gear. Experience with a switchgear manufacturer would be an advantage.

Apply quoting Vacancy No. 344/60MD on form AE6, available from the Establishments Officer, 53 Wake Green Rd, Moseley, Birmingham 13, to reach him not later than 16 Jan., 1961. (T 266)

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

CONTRACTING ENGINEER

REQUIRED in the Southport District. Salary within range £890/£1,015 per annum (N.J.B. F/9).

Candidates should possess technical qualifications in electrical engineering, and have had experience of electrical contracting including estimating and supervision of work on site.

Appointment subject to medical examination. Pension Scheme.

Special application forms, obtainable from the Manager, No. 1 Sub-Area, 24 Hatton Gdn, Liverpool 3, should be returned not later than 20 Jan., 1961. (T 261)

THE EAST MIDLANDS ELECTRICITY BOARD

Lincolnshire Sub-Area

DEMONSTRATOR, STAMFORD DISTRICT
Vacancy No. 148/60.

SALARY: N.J.C. Grade 1, £600 x £25—£700 per annum.

Applicants must be over 21 years of age and should hold the E.A.W. Electrical Housecraft Certificate for Demonstrators and be experienced in general Service Centre duties and be capable of conducting demonstrations and advising consumers on the selection and use of electrical appliances, both at the Service Centre and on consumers' premises.

A car will be provided by the Board and the successful applicant will be based at the District Office and required to reside in or near the Borough of Stamford. Ability to drive a motor vehicle will be an advantage.

Applications should be forwarded to The Manager, Stamford District, 14 Barn Hill, Stamford, within 14 days of the date of this advertisement. (T 264)

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

TRAINEE DEMONSTRATOR

REQUIRED in the Caernarvon District. Salary within range £265/£565 per annum, according to qualifications and experience, providing £320/£350 per annum approximately at age 18-19 years of age.

Applicants should have completed a full-time course of not less than two years at a Domestic Science Training Centre, and be prepared to continue with studies. A knowledge of electrical appliances will be an advantage. Ability to speak Welsh desirable.

Promotion to Demonstrator will depend on vacancies existing on completion of training, which would be approximately three years.

Appointment subject to medical examination.

Standard application forms obtainable from the Manager, No. 4 Sub-Area, Electricity Hse, Rhostyllen, nr. Wrexham, or from any District Office. Closing date: 25 Jan., 1961. (T 263)

CENTRAL ELECTRICITY GENERATING BOARD
Midlands Division
DEPUTY POWER STATION SUPERINTENDENT

REQUIRED at Worcester Power Station. N.J.B. service conditions, superannuable appointment, salary in accordance with Schedule A, Grade E3, £1,275/£1,410 per annum.

Candidates should have a wide experience in the operation and maintenance of a large modern power station and should have sound administrative ability. The possession of suitable technical qualifications will be an advantage.

Apply quoting vacancy No. 341/60MD on form AE6 available from the Station Superintendent, Worcester Power Station, Hylton Rd, Worcester, by 9 Jan., 1961. (T 235)

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD
CONSUMERS' ENGINEER

REQUIRED in the Southport District. Salary within range £965/£1,090 per annum (N.J.B. F/8).

Duties include estimating and preparation of specifications for contracting work, and advising consumers on electrical matters and utilisation of electricity. Technical qualifications desirable.

Appointment subject to medical examination. Pension Scheme.

Special application forms, obtainable from the Manager, No. 1 Sub-Area, 24 Hatton Gdn, Liverpool 3, should be returned not later than 20 Jan., 1961. (T 262)

BRITISH STANDARDS INSTITUTION
TECHNICAL STAFF

THE B.S.I. invites applications from ELECTRICAL ENGINEERS to join the staff of the Institution. This staff is responsible for the work of the Institution in the preparation of British Standards in co-operation with the various sections of industry and is required to plan and progress the work. They act as secretaries to technical committees.

Applicants should have a university degree or an equivalent professional qualification in electrical engineering.

There are three grades of appointment and salaries in the top grade range up to £2,000 plus: applications are invited for the grade which has at present a maximum salary of £1,350, the starting salary being dependent on individual qualifications and experience. The posts are pensionable.

Apply to the Establishments Officer, B.S.I., 2 Park St, London W.1. (T 256)

SOUTH EASTERN ELECTRICITY BOARD
ASSISTANT (WAYLEAVES)
WOKING DISTRICT

SALARY: £700 x £25—£775 per annum under N.J.C. Grade 2. Superannuable. Applicants should possess tact and personality and be experienced in work connected with the negotiaion of wayleaves and substation sites. Applications, quoting ET, on forms from District Manager, Seeboard, 4 Chobham Rd, Woking, by 18 Jan., 1961.

GEORGE WRAY,
Secretary.
(T 249)

THE SOUTH WALES ELECTRICITY BOARD
PRINCIPAL ASSISTANT

APPLICATIONS are invited for the position of Principal Assistant to the Area Secretary, Cardiff and East Central Area.

The Board are seeking a person able to adapt himself to a variety of tasks calling for administrative ability and experience. Much of the work concerns personnel and a knowledge in this field, though not essential, would be an advantage.

Salary: N.J.C. Grade 7 (£1,250/£1,355 per annum).

Applications stating age, present position, present salary, qualifications and experience, should be addressed to C. L. Townsend, ASSOCIATE I.E.E., Manager, Cardiff and East Central Area, 445-447 Cowbridge Rd East, Cardiff, to arrive not later than 21 Jan., 1961.

Envelopes should be endorsed "Principal Assistant—224/60."

R. G. WILLIAMS,
Secretary.
(T 254)

ATOMIC ENERGY RESEARCH ESTABLISHMENT
HARWELL

have

Vacancies for

Electronic Mechanics

Electricians and Electrical Fitters

Electro/Mechanical Instrument Mechanics

The successful applicants will be those with good training and experience and who are willing to train for a varied and interesting range of experimental work.

Several of these vacancies are with the National Institute for Research in Nuclear Science and the new establishment being built nearby at Culham.

- ★ Superannuation and sick pay schemes
- ★ Assisted transport scheme
- ★ Further Education facilities
- ★ Housing provided for married men living outside the Harwell transport area, or assistance given with house purchase.

Please send for explanatory booklet and application forms to:

Industrial Recruitment Officer, A.E.R.E.,
Harwell, Didcot, Berks.
H.159

(T 272)

ELECTRICAL ENGINEERS

With degree or equivalent qualifications and experience of machines, switchgear and protection design and application required for work in connection with nuclear and conventional generating stations.

Please apply stating full details of experience and salary required to Kennedy & Donkin, Consulting Engineers, 64 Royal Exchange, Manchester 2.

(T 268)

ARTHUR GUINNESS SON & CO. (Dublin) LTD.,
St. James's Gate Brewery, Dublin

have a vacancy for an ELECTRICAL ENGINEER with Higher National Certificate or degree in Electrical Engineering. Graduate or Corporate Member of the I.E.E. preferred. Age 26-32 years, with sound experience of distribution, installation and maintenance of electrical plant and of electronics as applied to process industries.

Appointment at first temporary, probably for at least one year; could lead to a permanency and the benefits of a non-contributory pension scheme. Good health essential.

Commencing salary between £880 and £1,220 commensurate with qualification and experience.

Financial assistance in moving home.

Apply in writing to The Chief Engineering, giving full particulars of age, education, qualifications, experience and positions held, in chronological order.

Travelling expenses allowed to those selected for interview.

(T 270)

POWER STATION ENGINEERING DESIGN

ENGLISH ELECTRIC, WHETSTONE, NEAR LEICESTER

1. Mechanical Engineers and Draughtsmen

2. Electrical Engineers and Draughtsmen

are required as soon as they can become free from their present engagements to work on the new Sizewell Nuclear Power Station Contract and on future project work. Previous experience of power station design and layout is necessary, but men who feel their experience to date could be readily adapted for this class of work will also be considered.

Please write giving details of qualifications and experience. We should prefer you to quote your present salary so that we do not waste your time in calling you for interview unless we consider we may be able to offer you reasonable financial improvement. Applications should be sent to Group Personnel Services, English Electric Hse, Strand, London W.C.2, quoting reference ET 1896P.

(T 216)

ELECTRICAL SHIFT CONTROL ENGINEER

THE UNITED KINGDOM
ATOMIC ENERGY AUTHORITY,
PRODUCTION GROUP,

requires a

TECHNICIAN

AT CAPENHURST WORKS,
CAPENHURST, CHESTER,

to be responsible to the Electrical Operation Control Engineer for:

(a) Operation of 132 kV switchgear, supervisory control of a number of large substations in accordance with instructions issued by the C.E.G.B. Grid Control Centre and operation and control of E.H.V., H.V. and M.V. switchgear and ancillary equipment on the extensive power networks associated with this large and continuously operating chemical engineering works.
(b) Supervison of Shift Control and Substation staff, issue of operational instructions and permits and preparation of statistics and electrical information.

A recognised electrical engineering apprenticeship, some years' experience in the control of large power networks with either a public electricity supply authority or a large industrial undertaking, and experience in the control of staff and industrial employees, are required. A good working knowledge of the various designs of switchgear, E.H.V., H.V. and M.V. and of all ancillary equipment including protective systems, experience in the operation of a Permit-to-Work certificate system and a sound knowledge of the Electricity Regulations, are also essential. Possession of an H.N.C. in Electrical Engineering, and a C.E.A. Authorisation or their equivalents, may be an advantage.

Salary will be assessed within the scale £1,410/£1,630 according to qualifications and experience.

Contributory Pension Scheme.

Housing or assistance towards legal expenses on house purchase may be available.

Send postcard for application form, quoting reference CAP.260/J.8, to Personnel Manager, at the above address.

Closing date: 16 January, 1961.

(T 221)

Do you want to be a

SALES ENGINEER

for Electrical Plant?

Johnson and Phillips Ltd. have vacancies for trainee-sales engineers and invite applications from ambitious young men with H.N.C. in electrical engineering. Vacancies exist at various branches in Britain and successful applicants will in due course handle the selling of capacitors, switchgear and transformers.

J. & P. are one of the leading companies in the industry with factories and selling organisations in this country and throughout the Commonwealth.

Applications giving details of training, etc., should be addressed to the Employment Manager, Johnson and Phillips Ltd., Charlton, S.E.7.

(T 239)

J. & P.

require a

SALES ENGINEER

IN EXETER

Johnson & Phillips Ltd. require an experienced man to handle the sales of electrical plant in Devon and Cornwall areas and to take charge of a cable depot in Exeter. This is an interesting and progressive post in an exceedingly pleasant territory which is expanding industrially.

Please send details of experience and salary required to the Employment Manager, Johnson & Phillips Ltd., Charlton, S.E.7.

(T 241)

IMPERIAL SMELTING CORPORATION LIMITED

Assistant Electrical Engineer

SWANSEA VALE

Applications are invited from suitably qualified engineers aged 23-35 for the position of Assistant Electrical Engineer at the above Corporation's Swansea Works. The duties will involve assistance in the supervision and carrying out of electrical maintenance and repair work, installation of new equipment and advising on suitability of electrical equipment.

Candidates who are Graduate Members of the Institution of Electrical Engineers with three years' electrical supervisory experience will be considered, but a B.Sc. or Associate membership of the Institution of Electrical Engineers is desirable.

Applications should be marked "Confidential" and submitted, quoting reference ET/ASEE, to:

Personnel Manager,
Imperial Smelting Corporation Ltd.,
St. Andrew's Rd,
Avonmouth.

(T 217)

CENTRAL ELECTRICITY GENERATING BOARD

South Eastern Division

THAMES SOUTH CONTROL CENTRE
EAST GRINSTEAD
FOURTH ASSISTANT ENGINEER
Vacancy No. 60B/60.

APPLICATIONS are invited for this appointment to assist in the department's planning works and possibly to undertake occasional shift duties in the Control Room. Experience of System Operation, Power Station or Transmission Practice and Technical Training to at least O.N.C. level are required.

Salary on N.J.B. BX.11, £855/£1,165 per annum, with prospect of promotion to BX.10 (maximum £1,245) and BX.9 (maximum £1,325) when suitably experienced. Shift allowance is payable when applicable.

Applications, giving age, details of experience, present position, etc., and quoting vacancy No., should be sent to the Personnel Officer, Central Electricity Hse, Lower Ham Rd, Kingston upon Thames, Surrey, to arrive by 18 Jan., 1961.

W. H. DUNKLEY,
Divisional Controller.
(T 246)

THE NORTH WESTERN ELECTRICITY BOARD

FOURTH ASSISTANT DISTRICT ENGINEER
STOCKPORT DISTRICT

DUTIES include assisting with the operation, construction and maintenance of the distribution system within the District, both underground and overhead including substations up to 33 kV.

The successful applicant will be required to undertake standby duty and should preferably be suitably qualified.

Salary Scale: £825/£940 per annum. Grade G.11. N.J.B. conditions.

Applications on forms to be obtained from the Manager, No. 3 Sub-Area, The North Western Electricity Board, Union St, Oldham, and returned to him not later than 14 Jan., 1961. (T 273)

CENTRAL ELECTRICITY GENERATING BOARD

South Western Division

ASSISTANT ENGINEER
(OPERATION AND EFFICIENCY)

REQUIRED at Hinkley Point Nuclear Power Station.

Superannuation Scheme. Salary: N.J.B. Class O, Grade 8, Scale 15, £1,650/£1,830 per annum.

Applications are invited for the position of Assistant Engineer (Operation and Efficiency), at Hinkley Point Nuclear Power Station.

The successful candidate will be responsible for assessing the technical performance of all plant and will be especially concerned with carrying out heat balances, efficiency trials, fuel handling and movement planning and generally assisting the Operation Superintendent in all aspects of Station Operation. He should have had experience in a conventional station but Nuclear experience is not necessary, as suitable training will be given. Qualifications leading to Corporate Membership of a Senior Engineering Institution or a University degree are desirable.

Applications on Form AE6/ACT obtainable from the Divisional Secretary, 26 Oakfield Rd, Bristol 8, should be completed and returned by 11 Jan., 1961, quoting vacancy No. ET/AV/179/60. (T 255)

SOUTH OF SCOTLAND ELECTRICITY BOARD

Lanarkshire Area

SENIOR ASSISTANT
(PREPAYMENT SECTION)
ACCOUNTANCY DEPARTMENT
AREA HEADQUARTERS

APPLICATIONS are invited for the appointment of Senior Assistant (Prepayment Section), Accountancy Department. Salary in accordance with the National Joint Council Agreement Grade 5, £1,020/£1,140 per annum.

Applicants should have had experience in the Income Section of a Public Utility Undertaking and have knowledge of Prepayment Meters and necessary accounting connected therewith.

continued in next column

continued from previous column

Preference will be given to persons holding recognised qualifications.

Application forms, which may be obtained from the undersigned, should be returned to this office duly completed not later than seven days from the appearance of this advertisement.

R. J. RENNIE,
Manager.

Montrose Cres,
Hamilton. (T 253)

CENTRAL ELECTRICITY GENERATING BOARD

SENIOR ASSISTANT ENGINEER

REQUIRED in the Nuclear Operations Branch of the Operations Department at Headquarters, London S.E.1.

The work of the Nuclear Operations Branch includes co-ordinating, with the Operating Regions, the commissioning, operation and maintenance of the Board's nuclear power stations, design liaison and liaison with the Nuclear Health and Safety Department.

Candidates should possess an engineering degree or equivalent qualification, and have sound practical experience in the commissioning, operation and maintenance of power stations or similar plant. Experience of nuclear plant, though desirable, is not essential.

Salary within the range £1,710/£2,455 p.a., according to duties and responsibilities.

Applications stating age, qualifications, experience, present position and salary, to the Personnel Officer, 24-30 Holborn, London E.C.1, by 30 Jan. Envelopes should be marked "Confidential, Ref.: ET/473." (T 251)

ASSISTANT ELECTRICAL ENGINEER required for London office of large multiple retail store, to assist in the preparation of drawings and specifications of electrical installations, etc. Applicants should have served an electrical apprenticeship and preferably attained City of Guilds Course "C" standard or equivalent and must be a capable draughtsman. Age 24-26 years. Salary: £650/£800 per annum according to age and experience. Write giving full particulars to Surveyor's Department, P.O. Box 209, North Row, Marble Arch, W.1. (T 215)

AN experienced OUTSIDE SALES REPRESENTATIVE, of good education and with a sound electrical background, is required by Crompton Parkinson Ltd. to sell their Induction Motors on his own initiative in the Hull area.

This is a staff appointment, carrying a good salary and pension benefits.

Please apply for application form to MA/P2, Crompton Hse, Aldwych, London W.C.2. (T 179)

GPO

A FIRST-CLASS JOB IN THE G.P.O.

Men between the ages of 20—35 are required to work in Central London on installing and maintaining telephone apparatus and transmission equipment. Older men, up to the age of 45, will be accepted if they have the experience which is particularly suitable.

Commencing pay is £9 16s per week rising to £12 2s.

Men who show ability to progress will be given every opportunity to qualify for Technical Officer posts on which the salary is £600 a year rising to £850. Further promotion is available.

Apply in writing stating age and experience to:

Chief Regional Engineer
(Ref. S/D2A(X2)),
London Telecommunications Region,
Waterloo Bridge House,
Waterloo Road,
London, S.E.1. (T 14)

AGENT required for the London area by a firm engaged on the manufacture of domestic electrical appliances—must have live connection amongst all wholesalers in London and the Home Counties. Apply in strictest confidence giving full details to Box No. 8127, Electrical Times. (T 237)

ELECTRICIAN required for Plantations Company in Liberia, West Africa. Age 30/45 Married/Single with at least five years' experience, able to supervise and, if required, carry out all types of electrical work, from ordinary wiring to operating Hydro Plant. Previous experience abroad and handling of native workmen preferable. Housing and car provided. Salary $500 per month.—Box No. 8123, Electrical Times. (T 197)

LUMENATED CEILINGS LTD. urgently require an experienced REPRESENTATIVE to call upon architects, consultants and users in important London area. Knowledge of lighting desirable. A car will be provided and the post is permanent and pensionable, and offers good prospects. Remuneration will be by way of a good salary and commission. Apply in strict confidence, Sales Manager, Alliance Hse, 12 Caxton St, S.W.1. (T 236)

M.K. ELECTRIC LTD. invite applications for position of AREA SALES REPRESENTATIVE for East Anglia, covering the counties of Norfolk, Suffolk, Cambridge and part Essex. Applicants must have good education and preferably a thorough knowledge of the marketing and distribution of Electrical Accessories. Application giving full particulars of past experience, age and salary required will be treated in strict confidence if addressed to the Sales Manager, M.K. Electric Ltd., Shrubbery Rd, Edmonton, London N.9. (T 195)

PHILIPS ELECTRICAL LTD., due to expansion of sales force, require a REPRESENTATIVE to sell lamp and lighting equipment to wholesalers, contractors and users in Berkshire and part of Surrey/Hampshire. The successful applicant will be required to reside on the territory and must be aged 30-35 years. A selling record in the electrical industry is preferable but not essential, for the chief qualities required are drive, initiative, and good educational background. A good salary is offered, car provided, position is progressive and pensionable. Write in strictest confidence to the Personnel Officer, Century Hse, Shaftesbury Ave, W.C.2, quoting ref.: BVM554. (T 238)

WANTED

WANTED for prompt cash, ferrous and non-ferrous SCRAP: also plant for dismantling. Buyers of second-hand machinery and plant for re-use.—W. and H. Cooper Ltd., 17 Brady St, Bethnal Green, E.1. (T 1)

APPOINTMENTS WANTED

TECHNICAL REPRESENTATION in S.E. offered by qualified Electrical Engineer on free-lance or part-time basis; own office, transport, etc.—Box No. 8111, Electrical Times. (T 125)

PATENTS

THE proprietor of British Patents Nos. 741103 and 741443, both entitled "Snap Acting Thermostat," offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern and Carlberg, 140 So. Dearborn St, Chicago 3, Illinois, U.S.A. (T 243)

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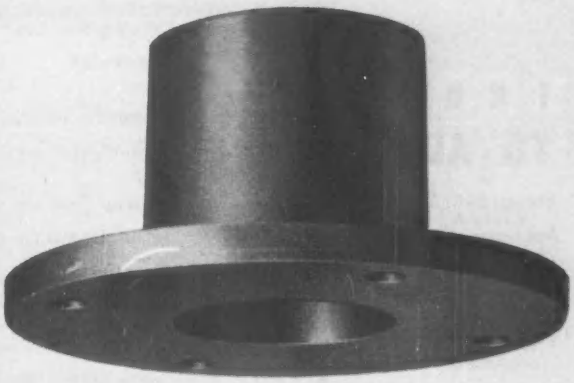

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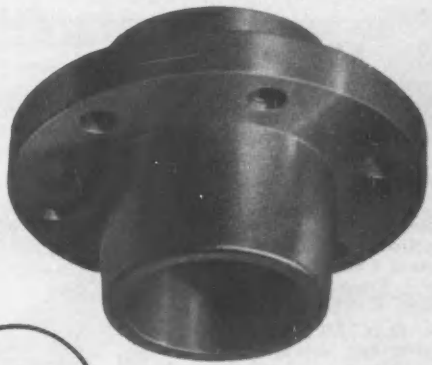

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INDEX TO ADVERTISERS

Abbott, Birks & Co. Ltd. 54
Associated Electrical Industries Ltd. (Cable Division) 20
Associated Electrical Industries Ltd. (Lamp & Lighting Division) *Cover* (iv)
Associated Electrical Industries Ltd. (Transformer Division) 42
Atlas Lighting Ltd. 55
Attwater & Sons Ltd. 54

Baldwin, H. J., & Co. Ltd. 21
Bridge Foundry Co. Ltd. 51
British Insulated Callender's Cables Ltd. 12
British Klockner Switchgear Ltd. ... 31
Brown, H. L., Ltd. 22
B.S.A. Tools Ltd.... ... ... *Cover* (ii)

Cementation Co. Ltd. 34
Chamberlain, Hookham Ltd. 3
Christy Bros. Ltd. 51
Collins Electrical Ltd. 6
Critchley Bros. Ltd. 53
Cryselco Ltd. 36

Diamond H Switches Ltd. 24
Donovan Electrical Co. Ltd. 32

Electrical Times Ltd. 52, 54
English Electric Co. Ltd. *Cover* (i), 19

Ferranti Ltd. 23

General Electric Co. Ltd. 25, 26, 27, 37
Guest, Keen & Nettlefolds Ltd. ... 40

Higgs Motors Ltd. 30
Hunt, A. H. (Capacitors), Ltd. ... 4

Kempston Electrical Co. Ltd. 54

Lancashire Dynamo Electronic Products Ltd. 15
London Pressed Hinge Co. Ltd. ... 22

Marine Engineering Co. (Stockport) Ltd. 33
Metallic Seamless Tube Co. Ltd. ... 31
Metway Electrical Industries Ltd. ... 33
Midland Electric Manufacturing Co. Ltd. 29

New Switchgear Construction Co. Ltd. 13

Otter Controls Ltd. 22

Parmiter Hope & Sugden Ltd. *Cover* (iii)
Parsons, C. A., & Co. Ltd. 56
Permali Ltd. 38
Philips Electrical Ltd. 14
Power Centre Co. Ltd. 1

Radiovisor Parent Ltd. 28
Reyrolle, A., & Co. Ltd. 35
Richardsons Westgarth (Hartlepool) Ltd. 41
Rowlands Electrical Accessories Ltd. ... 53

Saxonia Electrical Wire Co. Ltd. ... 51
Simplex Electric Co. Ltd. 5, 7, 9, 10, 11

Taylor Tunnicliff & Co. Ltd. 8

Venesta Foils Ltd. 16

West Insulating Co. Ltd. 51
Wootton & Co. Ltd. 13

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HOUSE-SERVICE METERS, all types can be obtained by return from Selectrics, Dept. E.T., Meter Hse, Factory Row, Castle Circus, Torquay. Phone 7218. (T 8)

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A quick guide to trouble finding in all classes of industrial electrical equipment. By the use of tables specially classified according to defects in plant, a direct lead is given to the causes of trouble and the appropriate action required. The tables also act as a check list to ensure that no possible cause is overlooked.

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This book will prove invaluable to all concerned with the care of electrical equipment.

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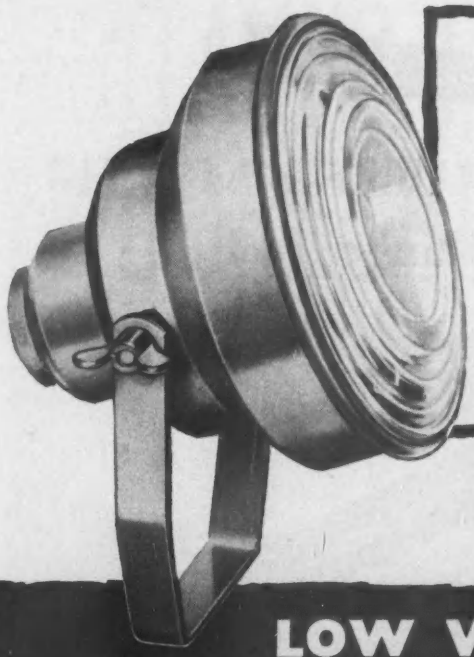

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KEMPSTON, BEDFORD. Phone: Kempston 2358

Safeguards Against the Explosion Hazard In Industry

by F. H. Mann, M.I.E.E.

An indispensable book to Design and Works Engineers

Price **6/-** *post free*

THE ELECTRICAL TIMES LTD.
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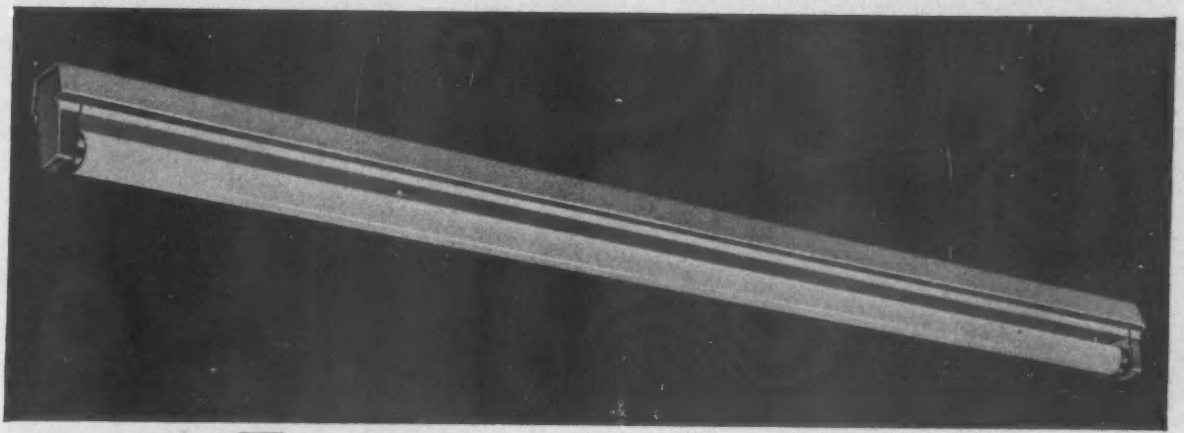
BRITAIN'S FASTEST SELLING FLUORESCENT FITTINGS *



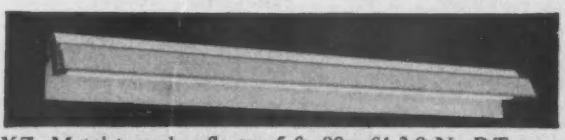
atlas SUPER-SLIM POPULAR PACKS

5 ft. fitting pre-packed complete with Atlas GP Quickstart Tube and control gear ready for installation.

£4-11-4

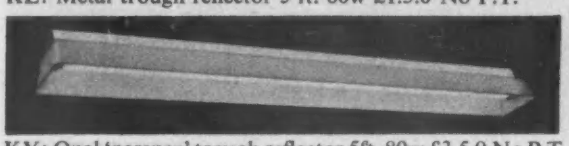
inc. P. TAX

AND A COMPLETE SERIES OF ATTACHMENTS TO COVER A WIDE RANGE OF COMMERCIAL AND INDUSTRIAL APPLICATIONS



KZ: Metal trough reflector 5 ft. 80w £1.3.0 No P.T.

KX: Metal angle trough reflector 5 ft. 80w 18/- No P.T.



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KW: Extruded plastic diffuser 5 ft. 80w £2.7.4 inc. P.T.

Super-slim chassis **Extremely light weight** **Totally enclosed chassis**

Compact control gear **Spring-loaded lampholders** **Available in 8 ft. 5 ft. 4 ft. and 2 ft.**

ATLAS LIGHTING LIMITED, THORN HOUSE, UPPER ST. MARTIN'S LANE, LONDON, WC2.

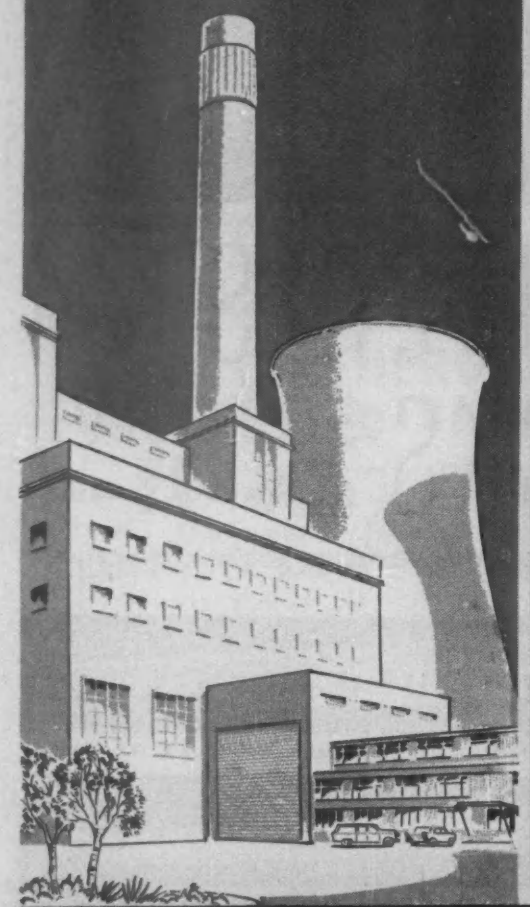
DTP

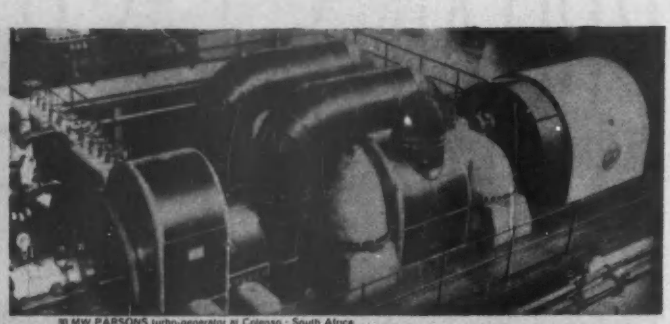
Recent

PARSONS

turbo-generator

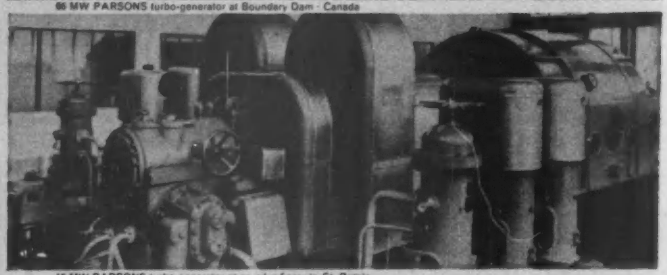
installations





30 MW PARSONS turbo-generator at Colenso - South Africa

65 MW PARSONS turbo-generator at Boundary Dam - Canada



10 MW PARSONS turbo-generator at an oil refinery in Gt. Britain

15 MW PARSONS turbo-generator at Muswellbrook N.S.W. - Australia

10 MW and 20 MW PARSONS turbo-generator at Trenton - Canada

C. A. PARSONS AND COMPANY LTD

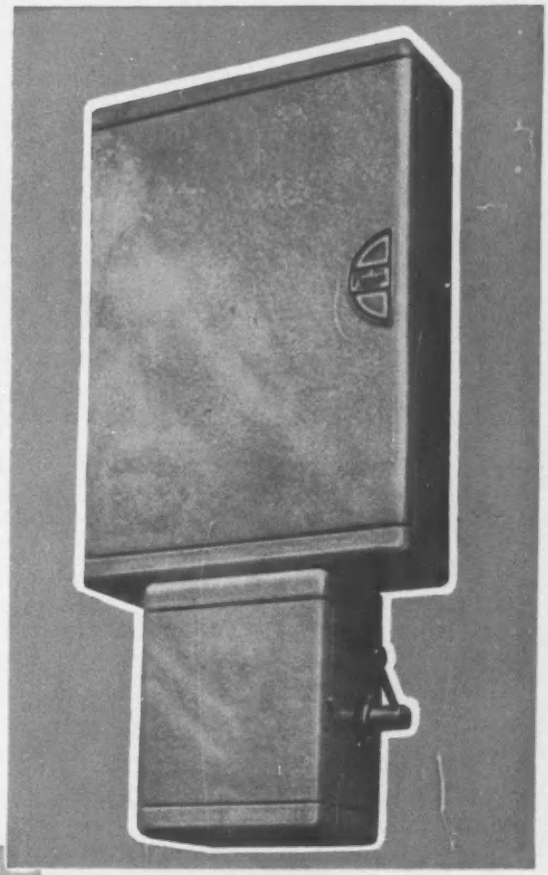
HEATON WORKS · NEWCASTLE UPON TYNE

Printed in England by Gibbs & Bamforth Ltd., St. Albans, for the Proprietors, THE ELECTRICAL TIMES LTD., and published at Sardinia House, Sardinia Street, London, W.C.2.

AEROFLEX
Fluvent

CABINET STYLE DISTRIBUTION BOARDS

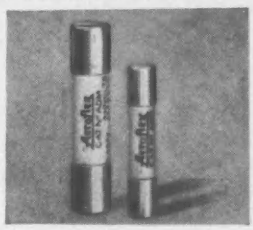
Widespread acceptance of surface mounting Fluvent Cabinet Style Boards has resulted in the production of Switches of similar exterior, intended principally for use as control switches mounted in conjunction with the boards. Both boards and switches have pressed steel cabinets which are cadmium plated and painted to give a grey metallic hammer finish.



The range has been further reinforced by the production of boards for recessed mounting, illustrated right. They are designed to allow the main body of the board to be sunk into a wall cavity of appropriate depth; the plasterwork and wall finish are then made up to the surrounding surface plate provided.

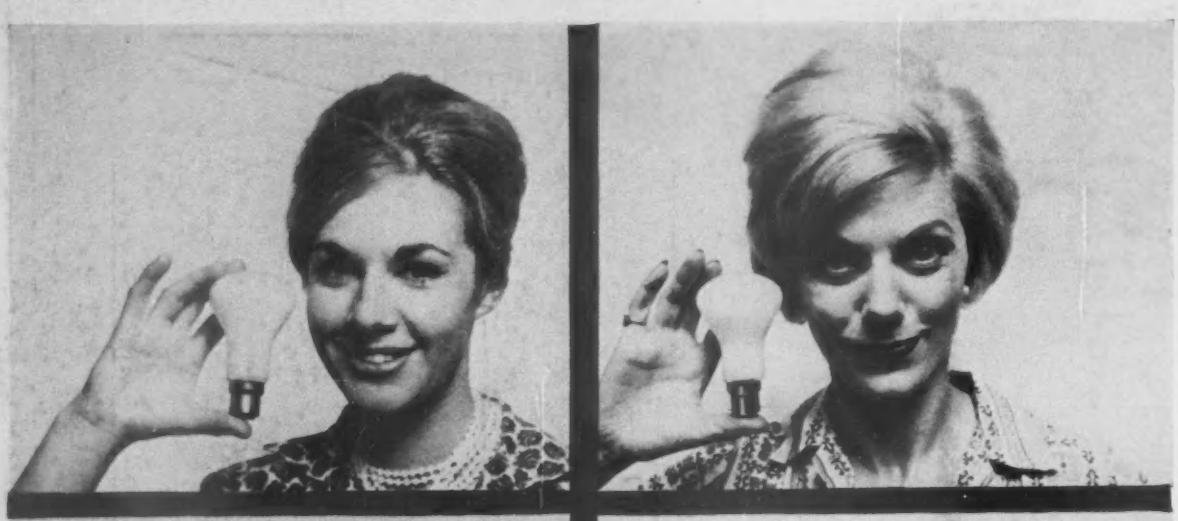
Aeroflex
ENERGY LIMITING FUSES

Fluvent Cabinet Style Distribution Boards are fitted with Aeroflex Energy Limiting High Breaking Capacity Rewireable Cartridge Fuses to BS.88-1952 Cat. 440 AC5 Class P. Standard fully wired cartridge fuse links are included unless otherwise specified, when appropriate underwirings can be fitted.



Parmiter Hope & Sugden Limited, **MANCHESTER, 12.**
London: 34 VICTORIA STREET, S.W.1. **Glasgow: 5 SOMERSET PLACE, C.3.**
Birmingham: 39/41 CARRS LANE, 4.

dm PH 130.



Why 4 out of 5 women go for Mazda Netabulb

4 out of 5 women prefer a smaller bulb that has a neater, trimmer shape
They go for NETABULB
4 out of 5 women like a bulb that's snug in the smaller modern fittings
They go for NETABULB
4 out of 5 women prefer a bulb whose whiter light is kinder to the eyes
They go for NETABULB

This may be an advertisement, but it's certainly no pipe-dream that "4 out of 5 women, given a choice, prefer the Mazda NETABULB". So say the Market Research men who did the counting in a recent independent survey.

A.E.I. LAMP & LIGHTING CO. LTD
Head Office: Melton Road, Leicester

AEI
Lamp and Lighting Co Ltd

Mazda lamps stay brighter longer

Electrical Groups

and

Associated Companies

ELECTRICAL
TIMES

PRICE 5/-
Free to subscribers

THIRD EDITION 1961

During the past year several important changes in the grouping of electrical companies have taken place; sufficient, it was felt, to justify a revised edition of this publication. This has offered the opportunity of enlarging the contents.

To keep the publication within reasonable size, only where groups are mainly electrical in character have we included all associated companies; in other cases only electrical subsidiaries are given. Therefore the publication is not to be regarded as comprehensive, but as one designed to meet the requirements of readers of the Electrical Times.

GUIDE TO TABLES

Where capital is shown it is capital issued

Code W = 90% or more shares owned

C = Over 50% of shares owned

I = Over 30% of shares owned

A = Has trading or technical agreement.

Electrical Groups

A1 **Aberdare Holdings Ltd.** £1,299,667
Aberdare Cables Ltd. W
Aberdare Engineering Ltd. W
Ivor Power Specialty Co. Ltd. W
Neckar Water Softener Co. Ltd. W
Neptune Brass & Aluminium Ltd. W
South Wales Electric (Pty) Ltd. W
South Wales Switchgear Ltd. W
Treforest Electrical Services Ltd. W

A2 **Aerialite Ltd.** £275,365
Aldhouse Milnes Ltd. W
D.R. Illuminations Ltd. W
Nettle Accessories Ltd. W
Ryecroft Electric Ltd. W

A3 **Allen, J. J. Ltd.**
Aish & Co. Ltd. W

A4 **Allen West and Co. Ltd.** £2,737,800
Allen West (Canada) Ltd. W
Allenwest Rhod. (Pty) Ltd. W
Allenwest (SA) (Pty) Ltd. W
Reason Manufacturing Co. Ltd. W
Société d'Usinage de Matériel Electrique I

A5 **Allied Insulators Ltd.** £2,298,181
Bullers Ltd. W
Electric and Ordnance Accessories Co. Ltd. W
Taylor Tunnicliff and Co. Ltd. W
Taylor Tunnicliff (Refractories) Ltd. W

A6 **Allied Ironfounders Ltd.**
Falco Electrical Appliances Ltd. W
Falkirk Iron Co. Ltd. W
Leisure Kitchen Equipment Ltd. W
(and other companies)

A7 **Alwyn Holdings Ltd.**
Rashleigh Phipps Ltd. W

A8 **Arusha Industries Ltd.**
Britannia Engineering Co. W
Klaxon Ltd. W

A9 **Ashley Accessories Ltd.**
Astral Switchgear Ltd. W
V.G. Porcelain Co. Ltd. W

A10 **Associated Electrical Industries Ltd.** £48,600,000
Manchester Group:
Associated Electrical Industries (Manchester) Ltd. W
Managing the following product divisions:
AEI Instrumentation Division
AEI Switchgear Division
AEI Traction Division
AEI Transformer Division
AEI Turbine-Generator Division
Associated Electrical Industries —GRS Ltd. W
Birka Regulator G.m.b.H. W
F. F. Chrestien & Co. Ltd. W
F. F. Chrestien & Co. Ltd (India) W
Micanite and Insulators Co. Ltd. W
Eugene Munsell & Co. W
Société d'Equipment Industriel Electro-Mécanique W
Sunvic Regler G.m.b.H. W
Switchgear Testing Co. Ltd. W
Rugby Group:
Associated Electrical Industries (Rugby) Ltd. W
Managing the following product divisions:
AEI Electronic Apparatus Division
AEI Heavy Plant Division
AEI Motor and Control Gear Division
AEI-Birlec Ltd. W
AEI Lamp and Lighting Co. Ltd. W
AEI Sound Equipment Ltd. W
Birlec-Efco (Melting) Ltd. C
Woolwich Group:
Associated Electrical Industries (Woolwich) Ltd. W
Managing the following product divisions
AEI Cable Division
AEI Construction (Cables and Lines) Division
AEI Radio and Electronic Components Division
AEI Telecommunications Division
AEI Plastics (Aldridge) Ltd. W
Fairfield Electric Wire Co. Pty Ltd. C
Henley Cables (India) Ltd. W
Henley Foundries Ltd. W
Lewcos (Australia) Pty Ltd. W
London Electric Wire Company and Smiths Ltd. W
Millett, Levens (Engravers) Ltd. C
Multi-Broadcast (Rentals) Ltd. W
Printed Circuits Ltd. C
Siemens Edison Swan (Australia) Pty. Ltd. W
Vactite Wire Company W
Overseas Group:
Associated Electrical Industries Overseas Ltd. W
AEI Limited (Australia) C
Australian Electrical Industries Pty. Ltd. C
Arrow Switches (Australia) Pty Ltd. C
Hard Metals Pty Ltd. C
Ediswan-Ekco (C.R.T.) Co. Pty Ltd. C
Associated Electrical Industries (India) Private Ltd. W
Associated Electrical Industries Mfg. Co. Private Ltd. W
Export Group:
Associated Electrical Industries Export Ltd. W
Associadas Eletro-Industriais do Brasil Ltda. W

Associated Electrical Industries (Canada) Ltd. W
Associated Electrical Industries Central Africa (Pvt) Ltd. W
Associated Electrical Industries (N.Z.) Ltd. W
Associated Electrical Industries (Pakistan) Ltd. W
Associated Electrical Industries South Africa (Pty) Ltd. W
Siemens Edison Swan (Canada) Ltd. W
Siemens (Edison Swan Pty) Ltd. W
Hotpoint Group:
AEI-Appliances Ltd. W
AEI-Hotpoint Ltd. W
AEI-Gala Ltd. W
AEI-John Thompson Nuclear Energy Co. Ltd. C
Service Companies:
AEI Divisional Management Co. Ltd. W
Associated Electrical Industries Estates Ltd. W
Associated Electrical Industries Finance Co. Ltd. W
Associated Electrical Industries Insurance Ltd. W
New Era Electrical Manufacturers Ltd. W
Associated Companies:
Battery Carbons Ltd. I
Birlefco-Lindberg Ltd. I
British Sealed Beams Ltd. I
Ediswan-Ekco (Australia) Pty Ltd. I
First Electric Corporation of South Africa Ltd. I
Glass Bulbs Ltd. I
Henley-Simplex (Pty) Ltd. I
Lamp Caps Ltd. I
Metro-Cutanit Ltd. I
Metropolitan-Vickers-Beyer, Peacock Ltd. I
Nuclear Graphite Ltd. I
Nucleonic Investments Ltd. I
Power Cables of Australia (Pty) Ltd. I
Siemens & General Electric Railway Signal Co. Ltd. I
Southern United Telephone Cables Ltd. I
Submarine Cables Ltd. I
Telephone Manufacturers of South Africa (Pty) Ltd. I
Wintronics Ltd. I

A11 **Automatic Telephone & Electric Co. Ltd.**
Associated Transistors Ltd. I
A.T. & E. (Bridgnorth) Ltd. W
A.T. & E. (Wigan) Ltd. W
Birkbys Ltd. I
British Telecommunications Research Ltd. C
Communication Systems Ltd. W
Enfield Tool Manufacturing Co. Ltd. C
Hivac Ltd. W
Precision Engineering Products (Suffolk) Ltd. C
A.T.E. de Venezuela S.A. W
A.T.E. Telefones Automaticos do Brasil S.A. W
Automatica Electrica Portuguesa S.A.R.L. W
Automatic Telephone & Electric Co. (East Africa) Ltd. W
Automatic Telephone & Electric Co. (New Zealand) Ltd. W
Automatic Telephone & Electric Co. (India) Private Ltd. W
Automatic Telephones (S.A.) Ltd. W
British Automatic Telephone & Electric Pty Ltd., Australia W
Communication Systems of Australia Pty. Ltd. W
Communication Systems of South Africa (Pty) Ltd. W
Telefonos Automaticos y Productos Electricos S.A. Argentine W
Telephone Manufacturers of South Africa (Pty) Ltd. I

Barton and Sons Ltd. B1
Barton Conduits Ltd. W
Barton Tubes Ltd. (Canada) W
Bartons Tube & Conduits Ltd. (S.A.) W
H. G. Richardson & Co. W

Belmos Co. Ltd., The £323,923 B2
Everett Edgcumbe Ltd. W

Bescol (Electric) Ltd. £29,648 B3
Smiths Switchgear Ltd. W

Bowthorpe Holdings Ltd. £1,000,000 B4
Bowthorpe Electric Co. Ltd. W
Bowthorpe Engineering Co. Ltd. W
Hellermann (Canada) Ltd. W
Hellermann Corporation (USA) C
Hellermann Ltd. W
Line Equipment Ltd. C
Paul Hellermann G.m.b.H. W
Tate Engineers Ltd. C

Braby, Fred'k., and Co. Ltd. B5
Auto Diesels Ltd. W
Bowler and Sidney Ltd. W
Diesel Equipment Ltd. W
Norman and Industrial Marine Engine Co. Ltd. W

Britannia Electric Lamp Works Ltd. £175,000 B6
Gnome Electric Lamp Works, The, Ltd. W
Noma Electric Co. Ltd. C

British Central Electrical Co. Ltd. B7
P. T. Bishop & Co. Ltd. W

British Electric Resistance Co. Ltd. £180,000 B8
Australian and NZ Elect. Ind. (Pty) Ltd. W
British Power Transformer Co. Ltd. W
Electric Products Ltd. W
International Power Transformers Ltd. W

British Electronic Industries Ltd. B9
Proposed new company to merge the assets of E. K. Cole Ltd. and Pye Ltd.

British Insulated Callender's Cables Ltd. B10
In the case of the following companies the code letter "C" indicates a subsidiary, regardless of whether the holding exceeds 90% or not.
Bartles (Carn Brea) Ltd. C
BICC-Burndy Ltd. I
Thomas Bolton & Sons Ltd. C

British Copper Refiners Ltd. C
British Dielectric Research Ltd. C
British Insulated Callender's Construction Co. Ltd. C
British Insulated Callender's (Submarine Cables) Ltd. C
British Telecommunications Research Ltd. I
Connollys (Blackley) Ltd. C
W. T. Glover and Co. Ltd. C
Industrial Reels Ltd. C
Lewis Gilder and Co. Ltd. C
Magnetic & Electrical Alloys Ltd. C
M.S.S. Recording Co. Ltd. C
Painter Bros. Ltd. C
Rotunda Ltd. C
St. Helens Cable & Rubber Co. Ltd. C
Sankey-Telcon Ltd. I
Scottish Cables Ltd. C
Southern United Telephone Cables Ltd. I
Submarine Cables Ltd. I
Telcon-Magnetic Cores Ltd. C
Telcon Metals Ltd. C
The Telegraph Condenser Co. Ltd. C
The Telegraph Construction & Maintenance Co. Ltd. C
Temco Ltd. C
Toolpro Ltd. C
Veedip Ltd. C
and overseas companies.

B11 **British Thermostat Co. Ltd.** **£1,060,000**
P. W. Baker and Sons Ltd. W
P. W. Baker and Sons (Sales) Ltd. W
Société Francaise des Thermostats S.A. W
Teddington Aircraft Controls Ltd. W
Teddington (Holland) N.V. W
Teddington Industrial Equipment Ltd. W
Teddington Refrigeration Controls Ltd. W
Teddington Autocontrols Ltd. W

B12 **Brook Motors Ltd.** **£1,062,461**
Brook Electric Motors (Canada) W
Brook Motor Corpn. (Florida) W
Brook Motor Corpn. (USA) W

B13 **Bucknall, Henry, and Sons Ltd.**
Control Heating Units (London) Ltd. W
R. E. Thompson and Co. (Sunbury) Ltd. W

B14 **Burco Dean Ltd.** **£868,750**
Burco Ltd. W
Dean Sales Promotion Ltd. W
G. L. Howarth and Co. Ltd. W
Nadex Ltd. W
Thomas Ashworth and Co. Ltd. W
W. H. Dean and Son Ltd. W

B15 **Burgess Products Co. Ltd.** **£450,000**
Burgess G.m.b.H. W

B16 **Bylock Electric Ltd.** **£135,000**
Bylock Distributors Ltd. W
CCA (Finance) Ltd. W
Electramaid Ltd. A
V.C.S. (Finance) Ltd. A

C1 **Cambridge Instrument Co. Ltd.**
Electronic Instruments Ltd. W
Cambridge Instrument Co. Inc. C
Cambridge Instrument Co. (Aust.) Pty. Ltd. C

Camp Bird Ltd. **C2**
Ambassador Radio and TV Ltd. W
A. Prince Industrial Products Ltd. W
Baldwin Central Products Ltd. C
Baldwin Engineering Equipment Ltd. C
Baldwin Durawire Cable Co. Ltd. C
Coolers and Venders Ltd. W
Creston Electric Ltd. W
Duratube and Wire Ltd. C
Electronic Reproducers Ltd. W
Electronic Reproducers (Components) Ltd. W
Hartley Installations Ltd. C
H. J. Baldwin of Canada Ltd. C
Kelly Acoustics Ltd. W
Limit Engineering Group Ltd. and subsidiaries W
Rowe Automatic Merchandising Co. Ltd. I
Vending Supply and Service Ltd. W

Chloride Electric Storage Co. Ltd. **£6,594,218** **C3**
Alkaline Batteries Ltd. C
Alklum Storage Batteries Ltd. C
Britannia Batteries Ltd. C
British Batteries Overseas Ltd. I
Chloride Batteries Ltd. W
D.P. Battery Co. Ltd. W
Ferrostatics Ltd. W
Holsun Batteries Ltd. W
Hymatic Engineering Co. Ltd. W
Patterson Lamps (1953) Ltd. C
Pritchett, Gold and EPS Co. Ltd. W
Rozalex Ltd. W
Shires and Co. (London) Ltd. W
Tudor Accumulator Co. Ltd. W
United Ebonite and Lorival Ltd. W

Christy Bros. Ltd. **C4**
Christy & Norris Ltd. W
Playle of Maldon Ltd. W
Christy Brothers (Wireless Relays) Ltd. W
Alderney Electricity Ltd. A

Claremont Electrical Distributing Co. Ltd. **C5**
British Electrical Distributors Ltd. W
Egacon Fittings Ltd. C
Newmarket Electrical Distributors Ltd. W
Southampton Electrical Distributors Ltd. W

Clarke T. and Co. Ltd. **C6**
Clarke T. (Wales) Limited W
K.S. Construction Co. Ltd. W

Clydesdale Supply Co. Ltd. **£816,667** **C7**
B. M. Levine Ltd. W
Carrick Trust Ltd. W
Clydesdale Television & Radio Co. Ltd. W
Clydesdale Rentals Ltd. W
Electrical Ohms Ltd. W
Jas. Allan & Co. (Aberdeen) Ltd. W
James Allan (Glasgow) Ltd. W
McCulloch & Young Ltd. W
Ronald Mason Ltd. W
Rowland Ltd. W
Tec Ltd. W

C8 **Cole, E. K., Ltd.** **£1,272,630**
American Tradair Corpn. (New York) W
Commercial Facilities Ltd. W
Dynatron Radio Ltd. W
Ediswan-Ekco (Aust) Pty Ltd. I
Egen Electric Ltd. W
Ekco Electronics Ltd. W
E. K. Cole (Colombia) Ltd. I
Ekco-Ensign Electric Ltd. I
Ekco Plastics Ltd. W
Ferranti Radio and Television Ltd. W
Kelly and Shiel (Ekco Prod.) Ltd. (Dublin) I
Kruger-Wilson Africa Ltd. I
Maldon Woodwork Ltd. I
Multisignals Ltd. I
National Ekco Radio and Eng. Co. Ltd. I
Twentieth Century Electronics Ltd. I
Ultimate-Ekco (NZ) Co. Ltd. (Auckland) I
V. C. Bond and Sons Ltd. I
Warm-Glow Co. Ltd. W
See also British Electronic Industries Ltd.

C9 **Combined Electrical Manufacturers Ltd.**
Bertram Thomas (Engineers) Ltd. W
Eastnor Electric Co. Ltd. W
Hackbridge & Hewittic Electric Co. Ltd. W
Hackbridge Electric Construction Co. Ltd. W
Hackbridge & Hewittic Electric Co. Canada Ltd. W
Hackbridge Hewittic Transformers & Rectifiers (Pty) Ltd., S.A. W
Harvey and Longstaffe Ltd. W
Kartret Switchgear Co. Ltd. W
New Switchgear Construction Co. Ltd. W
Switchgear & Cowan Ltd. W
Richard Whiffen Ltd. W
Sykes and Harrison Ltd. W

C10 **Concentric Manufacturing Co. Ltd.**
Alexander Controls Ltd. W

C11 **Coronet Industrial Securities Ltd.**
Coventry Factors Ltd. W
NCL Distributors (Electrical) Ltd. W

C12 **Cossor, A. C., Ltd.** **£1,500,000**
Beam Instruments Corpn. Inc. USA W
Best Products Ltd. W
Communications (Air) Ltd. C
Cossor Communications Co. Ltd. W
Cossor Instruments Ltd. W
Cossor Radar and Electronics Ltd. W
Cossor Valve Co. Ltd. W
E.M.I.-Cossor Electronics Ltd. (Canada) A
Floyd and Partners (Cables) Ltd. W
Plastic Tubes and Conduit Co. Ltd. W
Sterling Cable Co. Ltd. W
Sterling Cables (Canada) Ltd. W

C13 **Cozens and Sutcliffe (Holdings) Ltd.**
A. S. Duran and Co. Ltd. W
R.J.S. Services Ltd. W

C14 **Crabtree Electrical Industries Ltd.** **£1,550,000**
J. A. Crabtree and Co. Ltd. W
J. A. Crabtree (Pty) Ltd. (SA) W
C. M. Churchhouse Ltd. W
Robbins and Bradley Ltd. W

Crittall, Richard and Co. Ltd., **£525,000** **C15**
Abbey Heating Co. Ltd. W
Grierson Ltd. W
Magnetic Valve Co. Ltd. I
Richard Crittall Marine Ltd. W
Thermic Heating Co. Ltd. W
Thomas McDowell Ltd. W

Crompton Parkinson Limited **£7,928,257** **C16**
Atomic Power Constructions Ltd. A
Austin Crompton Parkinson Electric Vehicles Ltd. I
Bepco Canada Ltd. A
The British Electric Transformer Company Ltd. W
B. & S. Electrical Pty. Ltd. W
Cooke & Ferguson Ltd. W
Crompton Parkinson (Australia) Pty. Ltd. W
Crompton Parkinson (Central Africa) Ltd. W
Crompton Parkinson (Chelmsford) Ltd. W
Crompton Parkinson (Doncaster) Ltd. W
Crompton Parkinson Electrical Ltd. (Canada) W
Crompton Engineering Company (Madras) Ltd. I
Crompton Parkinson (South Africa) (Pty) Ltd. W
Crompton Parkinson (Stud Welding) Ltd. W
Crompton Parkinson (Works) Pvt. Ltd. (India) I
Derby Cables Ltd. W
F. & A. Parkinson Ltd. W
Greaves Cotton & Crompton Parkinson Pvt. Ltd. (India) I
Greaves Crompton Parkinson Ltd. (Pakistan) I
I.T.D. Ltd. I
L. Clarke & Company Ltd. W
Noyes Brothers Pty. Ltd. W
Rustyfa Ltd. A
Security Electric Pty. Ltd. (Australia) W
Young Accumulator Company Ltd. W

Deritend Group **D1**
E. J. Wilcock Ltd. W
Midland Electric Installation Co. Ltd. W
Shoolbread Electrical Co. Ltd. W

Dorman Smith Holdings Ltd. **£350,000** **D2**
Alorite Ltd. W
British Klockner Switchgear Ltd. W
Dorman and Smith Ltd. W
Dorman and Smith (Domestic) Ltd. W
D.S. Plugs Ltd. W
Hindustan Klockner Switchgear Ltd. I
John Booth Foundries Ltd. W

Drake and Gorham Ltd. **£225,000** **D3**
Drake and Gorham (Contractors) Ltd. W
Ottermill Switchgear Ltd. W

Dubilier Condenser Co. (1925) Ltd. **£746,538** **D4**
Isenthal and Co. Ltd. W
Mansbridge Condenser Co. Ltd. W

D5 **Duport Ltd.**
Revo Electric Co. Ltd. W
and other Companies

E1 **Edmundsons Electric Co. Ltd.** **£465,500**
Edmundsons Electrical Wholesalers Ltd. W
Edmundsons (Midlands) Ltd. W
T. Stanley Weston Co. Ltd. W
W. H. Stone and Co. (Cardiff) Ltd. W
West Wales Trading Co. (Milford Haven) Ltd. W
T. Beadle & Co. Ltd. W

E2 **Efco Ltd.** **£572,790**
Efco-Industrieofen A.G. W
Efco Furnaces Ltd. W
Efco (SA) (Pty) Ltd. C
Electric Furnace Co. Ltd. W
Electro Chemical Eng. Co. Ltd. W
Royce Electric Furnaces Ltd. W

E3 **Electric Construction Co. Ltd.** **£1,383,550**
ECC (Canada) Ltd. I
ECC Holdings (Pty) Ltd. W
ECC Ltd. (NZ) C
ECC (Moulded Breakers) Ltd. I
ECC (South Africa) (Pty) Ltd. C
Electric Construction Co. (Small Motors) Ltd. W
McColl Electric Works (Ltd. (Australia) A
Tyseley Foundry Ltd. W

E4 **Electric & Musical Industries Ltd.** **£14,704,000**
The Gramophone Co. Ltd., & overseas subsidiaries W
Columbia Graphophone Co. Ltd., & overseas subsidiaries W
EMI Records Ltd. W
EMI Electronics Ltd. W
EMI Sales & Service Ltd. W
Home Maintenance Ltd. W
Davey & Moore Ltd. W
Alpha Accessories Ltd. W
Marconiphone Co. Ltd. W
Parlophone Co. Ltd. W
Capitol Records Inc., U.S.A., & overseas subsidiaries W
EMI Cossor Electronics Ltd., Canada C
EMI (Australia) Ltd., & overseas subsidiaries C
EMI (South Africa) Ltd. W
Ardmore & Beechwood (South Africa) (Pty) Ltd. W
Ardmore & Beechwood (Belgique) S.A. W
The Gramophone Co. of Pakistan Ltd. C
Musica Argentina e Internacional S.R.L. W
Morphy-Richards Ltd. W
Morphy-Richards (Astral) Ltd. W
Morphy-Richards (Cray) Ltd. W
Morphy-Richards (Installations) Ltd. W
Morphy-Richards (Sales & Services) Ltd. W
Morphy-Richards (Yelsen) Ltd. W
Morphy-Richards (Australia) Pty. Ltd. C
Morphy-Richards (Canada) Ltd. W
Morphy-Richards Inc., U.S.A. W
Morphy-Richards (Italiana) S.p.a. W
Morphy-Richards (Nederland) N.V. W
Morphy-Richards Proprietary Ltd., South Africa W
Maybaum-Richards Verkaufsgesellschaft m.b.h. I
Morphy-Richards (Argentina) S.A. I
Morphy-Richards Salgs Organisation A/S Denmark W
Ardente Ltd. W
Ardente Acoustic Laboratories Ltd. W
Clarke & Smith Manufacturing Co. Ltd. I
Fairbanks Whitney Corporation (U.S.) A
Swedish S.A.A.B. Aircraft Co. A

Electrical Apparatus Co. Ltd. **£648,212** **E5**
Bray, Markham and Reiss Ltd. W
Claytat Ltd. W
Interohm Electrical Insulators Ltd. W
Process Control Gear Ltd. W
Switchboards Ltd. W

Electrical Components (Holdings) Ltd. **£1,011,905** **E6**
Electrical Components Ltd. W
F. D. Newcombe and Co. Ltd. W
Flinders (Wholesale) Ltd. W
J. F. Irvine and Co. Ltd. W
Santon (Wholesale) Ltd. W

Electro-Hydraulics Ltd. **E7**
Conveyancer-Fork Trucks Ltd. W
Conveyancer-Scott Electric Vehicles Ltd. W

Elliott-Automation Limited **£7,536,583** **E8**
A.B. Termostatik W
Associated Automation Limited W
Black Automatic Controls Limited W
B. & P. Swift Limited W
Bristol's Instrument Co. Limited W
Contactor (Pty.) Limited W
C. P. Clare Limited W
Electroflo Meters Co. Limited W
Electroflo Meters (Africa) (Pty.) Limited W
Elliott-Automation AG (Zurich) W
Elliott-Automation G.m.b.H. W
Elliott-Automation (Pty.) Limited (Australia) W
E-A Automation Systems Limited W
E-A Automation Services Limited W
E-A Technical Services Limited W
Elliott Brothers (London) Limited W
Elliott Brothers Sales Agencies Limited W
Elliott Nucleonics Limited W
Farris Engineering Limited W
Fisher Governor Co. Limited W
Fisher Governor Amsterdam N.V. W
Gilmoor Control Systems Limited W
Hallikainen Instruments Limited W
Hall Telephone Accessories Limited W
Isotope Developments Limited W
James Gordon & Co. Limited W
James Gordon Valves Limited W
Leybold-Elliott Limited C
Mechanical Automation Limited W
National Automatic Machines Limited W
Panellit Limited W
The Rheostatic Company Limited W
Rotameter Manufacturing Co. Limited W

	Sauter Controls Limited		W
	Société Anonyme la Thermostatique		C
	Swartwout Co. Limited		W
	Swartwout N.V.		W
	Webb Conveyors & Automation Limited		W
E9	**Elliott, B., & Co. Ltd.**		
	Adams Bros. & Burnley Ltd.		C
	Elliott Domestic Appliances Ltd.		W
	Mastermet Ltd.		C
	Mortimer Engineering Co. Ltd.		W
	Selecta Power Tools Ltd.		W
	Victoria Machine Tool Co. Ltd.		W
	and other companies		
E10	**Enfield Rolling Mills Limited**		
	Alcan-Enfield Alloys Ltd.		I
	Aston Chain & Hook Co. Ltd.		W
	Barker & Allen Ltd.		W
	Enfield Cables Ltd.		W
	Enfield Cables (Aust) Pty. Ltd.		W
	Enfield Cables (E. Africa) Ltd.		W
	Enfield Cables (NZ) Ltd.		W
	Enfield Cables (Rhodesia) Ltd.		W
	Enfield Cables (SA) (Pty) Ltd.		W
	Enfield Copper Refining Co. Ltd.		W
	Enfield Rolling Mills (Aluminium) Ltd.		W
	Enfield-Standard Power Cables Ltd.		I
	Enfield Zinc Products Ltd.		W
	English Salvi Co. Ltd.		W
	Holloway Metal Roofs Ltd.		W
	London Zinc Mills Ltd.		W
	W. E. Martin & Co. Ltd.		W
	Refrigeration Appliances Ltd.		W
	Watliff Co. Ltd.		W
E11	**The English Electric Co. Ltd.**	**£32,774,850**	
	Associated Transistors Ltd.		I
	British Aircraft Corporation		I
	Canadian Marconi Company		C
	Canmar Investment Co. Ltd.		W
	Companhia Marconi Brasileira		I
	Dick Kerr and Co. Ltd.		W
	D. Napier & Son (Canada) Ltd.		C
	D. Napier & Son Ltd.		C
	Emerson Radio of Canada Ltd.		C
	English Electric Aviation Ltd.		I
	English Electric Export and Trading Co. Ltd.		W
	English Electric Valve Co. Ltd.		W
	John Inglis Co. Ltd.		C
	Marconi (China) Ltd.		W
	Marconi Instruments Ltd.		W
	Marconi International Code Co. Ltd.		W
	Marconi International Marine Communication Co. Ltd.		I
	The Marconi Sounding Device Co. Ltd.		I
	The Marconi Television Co. Ltd.		W
	Marconi's Wireless Telegraph Co. Ltd.		W
	Napier Engines Inc.		C
	Phoenix Dynamo Manufacturing Co. Ltd.		W
	Robert Stephenson and Hawthorns Ltd.		W
	Scanners Ltd.		W
	The Vulcan Foundry Ltd.		W
	Willans and Robinson Ltd.		W
	Svenska Radio Aktiebolaget		C
	English Electric, Babcock & Wilcox and Taylor Woodrow Atomic Power Construction Co. Ltd.		I
	The English Electric Co. of Australia Pty Ltd.		W
	The English Electric Co. of Canada Ltd.		C
	The English Electric Co. (Central Africa) (Private) Ltd.		W
	The English Electric Co. of India (Private) Ltd.		W
	The English Electric Co. of New Zealand Ltd.		W
	The English Electric Co. of South Africa (Pty) Ltd.		W
	English Electric de Venezuela C.A.		W
	English Electric Espanola S.A.		W
	English Electric Marconi Argentina SRL		W
	English Electrica de Portugal Ltda.		W
	Marconi de Venezuela C.A.		W
	Marconi Italiana S.p.A.		C
	Marconi (South Africa) Ltd.		W
E12	**Ether Langham Thompson Ltd.**		
	Ether Langham Thompson (Italiana) Ltd.		W
	Automation Systems and Controls Ltd.		W
	Datum Metal Products Ltd.		W
	Electro Methods Ltd.		W
	Ether Ltd.		W
	J. Langham Thompson Ltd.		W
	J. Langham Thompson (Group) Ltd.		W
E13	**Eugene Ltd.**		
	Suter Electrical Engineering Co. Ltd.		C
E14	**The Ever Ready Company (Great Britain) Ltd.**		
	A/S Skaland Grafitverk (Norway)		W
	Battery Carbons Ltd.		W
	Berec (France)		I
	Berec International Ltd.		W
	Berec Radio Ltd.		W
	Chemical & Carbon Products Ltd.		W
	Compagnie Industrielle des Piles Electriques		I
	Ceramic Engineering Co. Ltd.		W
	Daimon G.m.b.H.		W
	Ever Ready (Ireland) Ltd.		I
	Eveready South Africa Ltd.		I
	Mallory Batteries Ltd.		I
	Superpila S.p.A. (Italy)		W
E15	**Evershed and Vignoles Ltd.**		
	Record Electrical Co. Ltd.		W
	Tinsley (Industrial Instruments) Ltd.		W
E16	**E.V. Industrials Ltd.**		
	Furse Wholesale Ltd.		W
	W. J. Furse & Co. Ltd.		W
	W. J. Furse & Co. (London) Ltd.		W
	W. J. Furse & Co. (Manchester) Ltd.		W
E17	**Expanded Metal Co. Ltd.**		
	Cressall Mfg. Co. Ltd.		W
F1	**Falk, Stadelmann and Co. Ltd.**	**£1,664,625**	
	Falks, Electrical (SA) (Pty) Ltd.		W
	Falks (NZ) Ltd.		C
	Ionlite Ltd.		C
	Irish Cables Ltd.		W
	Lighting Trades & Welsbach Ltd.		W
	Raydex Ltd.		W
	Smith and Ansell Ltd.		W

Stoves Ltd. W
Switchgear Equipment Ltd. C
United Electrical Co. Ltd. W
Veritas Heating Products Ltd. W
Wandleside Cable Works Ltd. W
Wandleside Warren Wire Co. Ltd. I
Wandleside National Cables Ltd. A

F2 **Fenner, J. H., and Co. (Holdings) Ltd.**
NGN Electrical Ltd. W

F3 **Firth Cleveland Ltd.**
Broadmead Ltd. W
Civic Radio Services Ltd. W
Escott Brothers Ltd. W
Firth Cleveland Instruments Ltd. W
Max-Stone Ltd. W
Stenor Ltd. W

F4 **Ford, Louis G., Ltd.**
Ford Wholesale Electric Ltd. W
Southern Hardware Factors Ltd. W
Wheeler Engineering Co. Ltd. W
Woking Wholesale Electrical Ltd. W
Trade Development Finance Ltd. W

G1 **Gas Purification and Chemical Company Limited**
A. B. Metal Products Ltd. W
Associated Office Machines Ltd. W
B. & R. Relays Ltd. W
Francis Street Properties Ltd. W
Gas Purification Ltd. W
Greencoat Electronics Ltd. W
Grundig (Great Britain) Ltd. W
Grundig Works (Northern Ireland) Ltd. A
E. G. Irwin & Partners Ltd. W
Johnson British Electric Ltd. W
Kingsway of London Ltd. W
Modern Machine Tools Ltd. W
Plyglass Ltd. C
Precision Plastics Ltd. W
Smart & Brown (Machine Tools) Ltd. W
Wolsey Electronics Ltd. W

G2 **General Cable Mfg. Co. Ltd.** **£280,000**
Controlled by F. McNeill and Co. Ltd.
Britannic Cables Ltd. W

G3 **General Electric Co. Ltd.** **£23,600,000**
Agricultural Supplies (Cambridge) Ltd. C
Battery Carbons Ltd. I
Branch Properties Ltd. W
Bushing Co. Ltd. I
Chamberlain and Hookham Ltd. W
Claude-General Neon Lights Ltd. C
Coldair Ltd. W
Columbian-General Blacks Ltd. I
Computer Developments Ltd. I
Cryselco Ltd. I
Express Lift Co. Ltd. W
Evenlite Tube Lamp Developments Ltd. I
G.E.C. Lighting Equipment Ltd. W
Glass Bulbs Ltd. I
GPA Tools and Gauges Ltd. W
Lamp Caps Ltd. I
Lumifax Ltd. C
Machlett X-Ray Tubes (GB) Ltd. W
M-O Valve Co. Ltd. W
Oriental Tube Co. Ltd. W
Parkhall Pottery Co. Ltd. W
Pirelli-General Cable Works Ltd. I
Pope's Electric Lamp Co. Ltd. W
Progressive Electrics Ltd. W
Reliance Telephone Co. Ltd. W
J. T. Rothwell and Co. Ltd. W
Salford Electrical Instruments Ltd. W
Siemens and General Electric Railway Signal Co. Ltd. I
Simplex Dairy Equipment Co. Ltd. C
Telephone Supplies Ltd. W
Watson and Sons (Electro-Medical) Ltd. C
Witton-James Ltd. W
Woods of Colchester Ltd. C
Amalgamated Electric Corpn. Ltd. (Canada) W
Anglo Argentine GEC Ltd. W
British GEC (Japan) Ltd. W
British GEC Pty Ltd. (Australia) W
British GEC (Canadian) Ltd. W
British GEC of Central Africa (Pty) Ltd. W
British GEC Ltd. (China) W
British GEC Ltd. (NZ) W
British GEC (Pty) Ltd. (SA) W
Collier and Beale Ltd. (NZ) C
Express Lift Co. (SA) (Pty) Ltd. W
Fraser and Chalmers of Canada Ltd. W
GEC of Burma Ltd. W
GEC of East Africa Ltd. W
GEC of Ghana Ltd. W
GEC of Nigeria Ltd. W
GEC of Trinidad Ltd. W
GEC of India Pvt. Ltd. W
GEC of India (Mfg) Pvt Ltd. W
GEC Overseas Services Ltd. W
GEC Iranian Technical Services Ltd. W
GEC (Malaya) Ltd. W
GEC Overseas Services Ltd. W
GEC of Pakistan Ltd. W
Premier Lift and Escalator Co. (Pty) Ltd. W

Goblin (B.V.C.) Ltd. **£750,000** **G4**
British Capeheart Corpn. Ltd. W
BVC Electronic Developments Ltd. W
BVC Industries (NI) Ltd. W
Goblin (African) (Pty) Ltd. W
Goblin Electric Appliances Ltd. W
Goblin (Canada) Ltd. W
Magneta (B.V.C.) Ltd. W
W. & S. Summerscales Ltd. W

Grampian Holdings Ltd. **G5**
Hall Electric Ltd. W
Kego Electric Company Ltd. W
New Endeavour Engineering Ltd. W

Grelco Ltd. **G6**
C. E. Sleeper Ltd. W

Hackbridge Holdings Ltd. **£1,350,000** **H1**
Bryce Elect. Const. Co. Ltd. W
Bryce Ltd. W
Hackbridge Cable Co. Ltd. W
Kelvin Metal Industries Ltd. W
Kelvin Non-Ferrous Metal Co. Ltd. W
London Transformer and Products Ltd. W
L. W. (Houses) Ltd. W
Mitcham Motor Co. Ltd. W
Siemens Schuckert (GB) Ltd. W

H2 **Hall-Thermotank Ltd.**
J. & E. Hall Ltd. W
Lumenated Ceilings Ltd. W
Vent-Axia Ltd. W
and other companies

H3 **Halsey's Electric Co. Ltd.**
Ellis & Mort Ltd. W

H4 **Harland Engineering Co. Ltd.** £800,000
Bepco Canada Ltd. A
Harland Engineering (Aust) Pty Ltd. I
Simon Equipment Ltd. W
Vivian Harland Eng. Co. (Pty) Ltd. I

H5 **Harper Engineering and Electronics Ltd.**
Baldwin Instrument Co. Ltd. W
Bell Engineering (Slough) Ltd. W
B. O. Morris (Holdings) Ltd. W
C. D. Monninger Ltd. W
Electrical Screw Ltd. W
Micalectric Ltd. W
Sidney Hole's Electric Vehicles Ltd. W
Spembly Ltd. W
Stanley Eng. Co. Ltd. W
and other companies

H6 **Harris and Sheldon (Holdings) Ltd.**
Harris and Sheldon (Electrical) Ltd. W

H7 **Hattersley (Ormskirk) Ltd.**
Beck & Co. (Meters) Ltd. C
Tuscan Engineering Ltd. C

H8 **Hawker Siddeley Industries Ltd.**
Owned by Hawker Siddeley Group Ltd.
Brush Electrical Engineering Co. Ltd. W
Fuller Electric Limited W
Hawker Siddeley Brush Turbines Ltd. W
High Duty Alloys Limited W
Kelvin Construction Company Ltd. W
Mirrlees, Bickerton & Day Ltd. W
McLaren Fabrications Limited W
The National Gas and Oil Engine Co. Ltd. W
Norstel & Templewood Hawksley Ltd. W
Petters Limited W

H9 **Hoover Ltd.** £5,500,007
Controlled by Hoover Co. (USA)
Hoover (Elect. Motors) Ltd. W
Hoover Washing (Machines) Ltd. W
Perivale Motors Ltd. W

H10 **Hopkinsons Ltd.**
Fielden Electronics Ltd. C

I1 **Ideal Building and Land Development Co. Ltd.**
Reliance Electrical Co. Ltd. W

I2 **Imperial Chemical Industries Ltd.**
Steatite & Porcelain Products Ltd. W
and other companies

I3 **Incandescent Heat, The, Co. Ltd.**
Metalectric Furnaces Ltd. W

J1 **James, Austin, & Son (Holdings) Ltd.**
Hartley Electromotives Ltd. W
Hartley Electromotives (East Africa) Ltd. W
Hartley Robertson Ltd. I

Johnson and Phillips Ltd. £2,917,187 **J2**
Aurora Lamps Ltd. W
British National Electrics Ltd. W
Johnson and Phillips (Aust) Pty Ltd. W
Johnson and Phillips SA (Pty) Ltd. W
Johnson and Phillips Transformers (Pty) Ltd. C

Kango Electric Hammers **K1**
Eagle Electrical Co. (Bedford) Ltd. W

Kangol Ltd. **K2**
Gillone Electric Ltd. W

Keith, Prowse and Co. Ltd. **K3**
John E. Dallas and Sons Ltd. C

Kenwood Manufacturing Co. Ltd. **K4**
Kenwood Manufacturing (Woking) Ltd. W
Kenwood Electrics Ltd. W
Kenwood G.m.b.H. Elektrogerate W
Kenwood Manufacturing (Australia) Pty. Limited W
Dishmaster (London) Ltd. W
Mayfair Engineers and Platers Ltd. W
Peerless & Ericsson Ltd. W
Peerless & Ericsson Pty. Ltd. W
P. & E. Holdings Pty. Ltd. W
Peerless & Ericsson (Canada) Ltd. W
Holbrooks Foundry Ltd. W
Electro-Plastics Ltd. W

K.G. Holdings Limited **K5**
E. Wight & Co. (Muswell Hill) Ltd. W
F. H. Wheeler (Bristol) Ltd. W
F. H. Wheeler & Co. Ltd. W
F. H. Wheeler (Southern) Ltd. W
Perihel Ltd. W
Tellux Ltd. W
W. S. Electronics (Extruders) Ltd. W
W. S. Electronics (Prod.) Ltd. W
and other companies

Land and General Developments Ltd. **L1**
Sterling Electric Holdings Ltd. W
Electrix Ltd. W
Russell Newbury & Co. Ltd. W
Sterling Engineering Co. Ltd. W
Sterling Incandescent Co. Ltd. W

Laurence, Scott and Electromotors Ltd. **L2**
£1,676,530
Enclosed Motor Co. Ltd. W
Printing and Paper Drives Ltd. C
Tri-Com Patents Ltd. W
Walter McGee and Son Ltd. W

Lloyds Packing Warehouses (Holdings) Ltd. **L3**
Argosy Radiovision Ltd. W
Combined Radio and Television Services Ltd. W
Lloyds (Manchester) Elec. Industries Ltd. W
Long & Crawford Ltd. W
Radio Gramophone Dev. Co. Ltd. W
Regentone Products Ltd. W
Regentone Radio and Television Ltd. W

United Components Ltd. W
Welded & Allied Products Ltd. W

L4 **London Brick Co. Ltd.**
Transformers (Watford) Ltd. W

L5 **London Fan & Motor Co. Ltd.**
Batwin Electric Motors Ltd. W

L6 **Low & Bonar Ltd.**
Bonar Long & Co. Ltd. W
Sturrick Power Installations Ltd. W

M1 **Mann Egerton & Co., Limited**
Botwoods Limited W
Greyfriars Vehicle Contracts Limited W
Mann Egerton Finance Limited W
W. H. Johnson and Sons Limited W

M2 **Marryat and Scott Holdings Ltd.** £300,000
Austin Lifts Ltd. W
GMP Ltd. I
John Bennie Ltd. W
Marris's (Engs.) Ltd. W
Marryat and Place Ltd. W
Marryat and Scott Ltd. W
Marryat's East Africa Ltd. W
Waring, Withers and Chadwick Ltd. C

M3 **Mavor and Coulson Ltd.**
Austin Hoy and Co. (Holdings) Ltd. W
Mavor & Coulson (S.A.) Ltd. W
M. & C. Switchgear Ltd. W

M4 **Melbray Group Ltd.**
Kenneth E. Beswick Ltd. W
R. A. Brand (Holdings) Ltd. C
The British Rototherm Co. Ltd. W
Commercial X-Rays Ltd. W
Manlove, Alliott and Co. Ltd. W
Melbray Ltd. W
Quartons (Holdings) Ltd. W

M5 **Metal Industries Ltd.**
Avo Ltd. W
Brookhirst Igranic Ltd. W
Brookhirst Igranic S.A. (Pty.) Ltd. W
Cable Jointers Ltd. W
Crypto Ltd. W
Crypton Equipment Ltd. W
Dynamo & Motor Repairs Ltd. W
Fawcett Preston & Co. Ltd. W
Foster Electrical Supplies Ltd. W
Foster Transformers Ltd. W
J. G. Statter & Co. Ltd. W
Lancashire Dynamo Central Africa (Pvt.) Ltd. W
Lancashire Dynamo & Crypto Ltd. W
Lancashire Dynamo Electronic Products Ltd. W
Lancashire Dynamo Group Sales Ltd. W
Lancashire Dynamo Nevelin Ltd. W
Lacnashire Dynamo South Africa (Pty.) Ltd. W
Malcolm & Allan (London) Ltd. W
Metal Industries Europe S.A. W
Metal Industries India Ltd. W
M.I. Australia Pty. Limited W
Minerva Mouldings Ltd. W
Taylor Electrical Instruments Ltd. W
International Rectifier Co. (Great Britain) Ltd. I
Bepco Canada Ltd. A
Mysore Electrical Industries Ltd. A
Power Construction Ltd. A
Rustyfa Ltd. A
Sunimac Ltd. A
and other companies

Midland Electric Manufacturing Co. Ltd. £1,575,000 M6
J. H. Tucker and Co. Ltd. W
Kersons Mfg. Co. Ltd. W

Mossley Blanket and Carpet Co. (Holdings) Ltd. M7
Permaheat (Mossley) Ltd. W

Newman Industries Ltd. £387,422 N1
Newman Industries (Aust) Pty Ltd. W
Newman Electric Motors Inc. W

Parkinson Cowan Ltd. P1
Bastian & Allen Ltd. W
Measurement Eng. Ltd. (NZ) W
Parkinson Cowan Appliances Ltd. W
Parkinson Cowan Measurements W

Parmiter, Hope and Sugden Ltd. P2
J. F. Collier and Co. Ltd. W

Parsons, C. A., and Co. Ltd. £9,600,000 P3
Anglo-Great Lakes Corpn. Ltd. I
C. A. Parsons of Australia Ltd. W
C. A. Parsons of Canada Ltd. W
C. A. Parsons and Co. Rhodesia Pvt. Ltd. W
C. A. Parsons and Co. (SA) (Pty) Ltd. W
Nuclear Power Plant Co. Ltd. I
Parolle Electric Plant Co. Ltd. I
Sir Howard Grubb Parsons and Co. Ltd. W

Philips Electrical Industries Ltd. P4
(*Controlled by Philips Incandescent Lamp Works, Eindhoven*)
Ada (Halifax) Ltd. C
Cossor Radio and Television Ltd. W
Mullard Ltd. W
Philips Electrical Ltd. W
Stella Lamp Co. Ltd. W
Stella Radio and Television Co. Ltd. W

Phoenix Telephone and Electric Holdings Ltd. £458,570 P5
Acquired by Combined Telephone Holdings Ltd.
B.O.B. (Arundel) Ltd. W
Correx Communication Equip. (1948) Ltd. W
Phoenix Appliances Ltd. W
Phoenix Internal Telephone Systems Ltd. W
Phoenix (The) Telephone and Elect. Works Ltd. W
Private Telephone and Electric Co. Ltd. W
Rotosigns Ltd. W

Plessey, The, Co. Ltd. P6
Amar Tool and Gauge Co. Ltd. W
Cottage Laboratories Ltd. W
Garrard Eng. & Mfg. Co. Ltd. W

Hagan Controls Ltd. C
Ketay Ltd. C
Leigh Electronics Developments Ltd. W
Machine Products Ltd. W
Plessey Co. of Canada Ltd. W
Plessey Inc. W
Plessey International Ltd. W
Plessey (Northern Ireland) Ltd. W
Plessey Nucleonics Ltd. W
Power Auxiliaries Ltd. C
Preformations Ltd. C
Rosite Ltd. C
Semiconductors Ltd. C
Technical Ceramics Ltd. C
Wireless Telephone Co. Ltd. W

P7 **Powell Duffryn Ltd.**
Hurseal Ltd. W
Gulf Radiators Ltd. W
and other companies

P8 **Power Securities Corporation** **£2,500,000**
Balfour Beatty and Co. Ltd. W
Balfour Beatty and Co. (Canada) Ltd. W
Balfour Beatty (Overseas) Ltd. W
Duncan Watson (Elec. Eng.) Ltd. W
Essay Electrical Co. Ltd. W
Impervious Stone Co. Ltd. W
James Kilpatrick and Son Ltd. W
Metropolitan Construction Co. Ltd. W
Murdoch and Brooks Ltd. (Iraq) W
Russell Construction Ltd. (Canada) W
Stent Precast Concrete Ltd. W
Tersons Ltd. W

P9 **Pullin, R. B. and Co. Ltd.** **£679,300**
Aldis Brothers Ltd. W
Donvin-Dumar Ltd. W
Measuring Instruments (Pullin) Ltd. W
Neville Brown & Co. Ltd. W
Pullin Optical Co. Ltd. W
Stanley Cox Ltd. W

P10 **Pye Ltd.** **£6,927,167**
Airdrie Electronics Ltd. W
Cambridge Works Ltd. W
Carrington Manufacturing Co. Ltd. I
Cathodeon Crystals Ltd. W
Cathodeon Electronic Ltd. W
Cathodeon Ltd. W
Corran Works Ltd. W
Faraday Electronic Instruments Ltd. W
Hollingsworth Printing Co. Ltd. C
Holloway Engineering Works Ltd. W
Invicta Radio Ltd. W
Labgear Ltd. W
L. G. Hawkins and Co. Ltd. W
The Lindley Thompson Transformer & Service Co. Ltd. W
Magnetic Devices Ltd. W
Newmarket Transistors Ltd. C
Pamphonic Reproducers Ltd. W
Pam (Radio & Television) Ltd. W
Pye Electric Ltd. W
Pye Industrial Electronics Ltd. C
Pye Marine Ltd. W
Pye Telecommunications Ltd. W
Pye T.V.T. Ltd. W
W. G. Pye & Co. Ltd. W
Radio & Television Services Ltd. W
W. Bryan Savage Ltd. W
Telephone Manufacturing Co. Ltd. C
T/V Manufacturing Ltd. W
Unicam Instruments Ltd. W
Unidare Ltd. A
United Rentals Ltd. W
Woodcraft Productions (Cambridge) Ltd. W
W. Watson and Sons Ltd. W
See also British Electronic Industries Ltd.

Radiation Ltd. **R1**
Ascot Lamps and Lighting Ltd. W
Electrical Division of Radiation Ltd. W
Jackson Industries Ltd. W
Parnall (Yate) Ltd. W
Thor Appliances Ltd. W
and other companies

Radio and Television Trust Ltd. **R2**
Airmec Ltd. W
British Communications Corporation Ltd. W
Thermionic Products (Electronics) Ltd. A

Rawlplug Co. Ltd. **£1,025,000** **R3**
Automatic Controls Ltd. W
Rawlplug Products (Canada) Ltd. W

Reliance-Clifton Cables and Industrial Products Ltd. **£745,190** **R4**
Belfast Cables Ltd. C
Patent Lighting Co. Ltd. W
Reliance Cords and Cables Ltd. W
Strathlea Investment Ltd. W

Reyrolle, A., and Co. Ltd. **£5,481,911** **R5**
A. Reyrolle and Co. (Rhodesia) Ltd. W
A. Reyrolle and Co. (SA) (Pty) Ltd. W
British Short Circuit Testing Station Ltd. W
Bushing Co. Ltd. C
C. A. Parsons and Co. Ltd. A
J. H. Holmes and Co. Ltd. W
Parolle Electric Plant Co. Ltd. I
A. Reyrolle & Co. (NZ) Ltd. W

Richardsons, Westgarth and Co. Ltd. **£5,910,876** **R6**
Atomic Power Constructions Ltd. I
Geo. Clark (Sunderland) Ltd. W
Humber Graving Dock & Eng. Co. Ltd. W
North-Eastern Marine Eng. Co. Ltd. W
Parsons Marine Turbine Co. Ltd. W
Richardsons Westgarth Atomic Ltd. W
Richardsons Westgarth (Hartlepool) Ltd. W
Richardsons Westgarth Inc. W

Riley and Neate Ltd. **£40,000** **R7**
Preformed Line Materials (Great Britain) Ltd. C

Royal Worcester Ltd. **R8**
Welwyn Electric Ltd. W

Scott, James (Electrical Holdings) Ltd. **S1**
Atkins, Robertson & Whiteford Ltd. W
Clyde Engineering & Equipment Co. Ltd. W
Contropanels Ltd. W
Engineering Rentals Ltd. W

James Scott & Co. (Electrical Engineers) Ltd. W
James Scott & Co. (Electricity Service Centres) Ltd. W
James Scott (Electronic Engineering) Ltd. W
Malcolm and Allan Ltd. W

S2 Simm's Motor and Electronics Corpn. Ltd. £2,866,420
Aircraft Steel Structures Ltd. W
A. R. Parsons and Co. Ltd. W
British Centralab Ltd. W
British Vacuum Flask Co. Ltd. W
Cawkell Research and Electronics Ltd. W
Clearex Products Ltd. W
Dawe Instruments Ltd. W
Hadrill and Horstmann Ltd. W
Horstman Ltd. W
Industrial Fan and Heater Co. Ltd. W
Lester Plastics Ltd. W
LMK Mfg. Co. Ltd. W
London Colney Service Station (1947) Ltd. W
M.E.C. Coolants Ltd. W
M.E.C. Transmissions Ltd. W
Mono Cam Ltd. W
N.S.F. Ltd. W
Remax Ltd. W
R.F. Landon and Partners Ltd. W
Simplus Products Ltd. W
Simm's Motor Units Ltd. W
Thompson Manufacturing Co. Ltd. W

S3 Smith, S., and Sons (England) Ltd.
Kelvin and Hughes Ltd. C
Smith's Aircraft Instruments Ltd. W
Smith's Industrial Instruments Ltd. W
and other companies

S4 Southern Areas Electric Corpn. Ltd. £783,484
Carrick Eng. (Stewarton) Ltd. W
Designs and Installations Ltd. W
Globelite Industries Ltd. W
Mawdsley's Ltd. W
Resoid Ltd. W
Ross, Courtney and Co. Ltd. W
Tyer and Co. Ltd. W

S5 Standard Telephones and Cables Ltd.
Controlled by International Standard Electric Corporation
Enfield-Standard Power Cables Ltd. I
Kolster-Brandes Ltd. W

S6 Stanhay (Ashford) Ltd.
Ray Electricals (Folkestone) Ltd. W

S7 Stone, J. and F., Lighting and Radio Ltd. £1,200,000
Bookers Lighting and Radio Ltd. W
Chain Store Finance Trust Ltd. W
District Supplies Ltd. W
Dynaport Radio & Television Ltd. W
F. W. Allen (Bristol) Ltd. W
S. Grey and Co. (1939) Ltd. W

S8 Stone Platt Industries Ltd.
Austinlite Ltd. W
Carlyle Air Conditioning & Refrigeration Ltd. A
Epsylon Industries Ltd. W
Hayward Tyler & Co. Ltd. W
Platt-Schindler Lifts Ltd. I
Stone-Chance Ltd. W
J. Stone & Co. (Deptford) Ltd. W
Sumo Pumps Ltd. W
Tweedales & Smalley Ltd. W
The Winsor Engineering Co. Ltd. C

Strand Electric Holdings Ltd. £258,750 **S9**
Strand Electric and Eng. Co. Ltd. W
Implitico Ltd. W
Tyler and Freeman Ltd. W
Strand Electric (Australia) Pty. Ltd. W
Strand Electric Ltd. (Canada) W

Sumner, Francis (Holdings) Ltd. **S10**
Fleet Electrics (Retail) Ltd. W
Reliance T.V. Service Ltd. W
P. A. Ridgers Ltd. W
View Rentals (City) Ltd. W
Llewelyn's Electrical Ltd. W

Telefusion Ltd. **T1**
Browns (Llandudno) Ltd. W
Telefusion (Manchester) Ltd. W

Telegraph Condenser Co. Ltd. **T2**
Sprague Electric Co. A
United Insulator Co. Ltd. W

Thompson, John (Wolverhampton) Ltd. **T3**
John Thompson Instrument Co. Ltd. W
Tappan Co. (US) A
SA Astar (Argentina) A

Thorn Electrical Industries Ltd. £2,994,375 **T4**
African Lamps Pty Ltd. C
Atlas Lighting Ltd. W
Austin Clarke (London) Ltd. W
Beam-Echo Ltd. W
British Radio Corpn. Ltd. W
Brimar Ltd. W
Champion Electric Corpn. W
Deutsche Atlas G.m.b.H. W
Ekco Ensign Electric Ltd. C
Elgar Research Laboratories Ltd. W
Ensign Lamps (Aust) Pty Ltd. W
Evansville Cabinet Co. Ltd. W
Ferguson Radio Corpn. Ltd. W
F. H. Marshall and Co. Ltd. W
Geo. Forrest and Son Ltd. W
Lamp Presscaps Ltd. W
Manifold Machinery Co. Ltd. W
Nash and Thompson Ltd. W
Newhaven Cabinet Works Ltd. W
N. Herrmann Ltd. W
Philco GB Ltd. W
Philco (Overseas) Ltd. W
Smart and Brown (Eng.) Ltd. W
Sylvania Thorn Colour Television Labs. Ltd. I
Talent European Co. Ltd. W
Talent Furniture Ltd. W
Thorn Elect. Ind. (Aust) Pty Ltd. W
Thorn Electrical Ind. (NZ) Ltd. W
Thorn Electrical Ind (SA) Pty Ltd. W

	Tricity Cookers Ltd.	W
	Tricity Finance Corporation Ltd.	I
T5	**Tilling, Thomas, Ltd.**	
	Newey and Eyre Ltd.	W
T6	**Truvox Engineering Co. Ltd.**	
	Rola Celestion Ltd.	W
	Truvox Ltd.	W
T7	**Tube Investments Ltd.**	
	Electrical Division	
	A. P. Lundberg and Sons	W
	Mersey Cable Works Ltd.	W
	Metallic Seamless Tube Co. Ltd.	W
	Power Centre Co. Ltd.	W
	Simplex Electric Co. Ltd.	W
U1	**Unidare Ltd.**	**£1,500,000**
	Bessbrook Products Ltd.	A
	Irish Overseals Ltd.	W
	Telecommunications Ltd.	I
	Unidare Eng. Ltd.	W
U2	**United Molasses Co. Ltd.**	
	E. N. Bray Ltd.	W
V1	**Venner Ltd.**	**£354,000**
	Venner Accumulators Ltd.	W
	Venner Electronics Ltd.	W
	Venner Time Switches Ltd.	W
W1	**Walsall Conduits Ltd.**	
	A. G. Hackney & Co. Ltd.	W
	Eureka Conduits Ltd.	W
	Walsall Hardware Mfg. Co. Ltd.	W
W2	**Westinghouse Brake and Signal Co. Ltd.**	
	Douglas (Kingswood) Ltd.	W
	Gresham & Craven Ltd.	W
	Gresham & Craven of India (Private) Ltd.	W
	Heatly & Gresham Ltd.	W
	H. Hewins Limited	W
	Hobbs Transmission Ltd.	I
	McKenzie & Holland (Australia) Pty. Ltd.	W
	Partridge Wilson & Co. Ltd.	I
	Radio Corpn. of America	A
	The Railway Signal Co. Ltd.	C
	Saxby & Farmer (India) Private Ltd.	W
	W. R. Sykes Interlocking Signal Co. Ltd.	W
	Westinghouse Brake (Australasia) Pty. Ltd.	W
	Westinghouse Brake & Signal Co. S.A. (Pty) Ltd.	C
	Westinghouse Electric Corpn. of U.S.A.	A
	Westinghouse Garrard Ticket Machines Ltd.	C
	Western Electric Co. Inc.	A
W3	**Ward and Goldstone Ltd.**	
	J. S. Feress Ltd.	W
	Volex Electrical Products Ltd.	C
	T. M. C. Harwell (Sales) Ltd.	C
	Ward and Goldstone (Auto and Aircraft Equip.) Ltd.	W
	Ward and Goldstone (Export) Ltd.	W
	Ward and Goldstone (Plastics) Ltd.	W
Y1	**Yorkshire Switchgear and Eng. Co. Ltd.**	
	Electro Mechanical Manufacturing Co. Ltd.	W

Index to Subsidiaries

Where the name of a subsidiary clearly reflects that of the parent company, it may not be indexed. This particularly applies with overseas companies.

Abbey Heating Co. Ltd.	C15
A.B. Metal Products Ltd.	G1
A.B. Termostatik	E8
Ada (Halifax) Ltd.	P4
Adams Bros. & Burnley Ltd.	E9
African Lamps Pty Ltd.	T4
Agricultural Supplies (Cambridge) Ltd.	G3
Aircraft Steel Structures Ltd.	S2
Airdrie Electronics Ltd.	P10
Airmec Ltd.	R2
Aish & Co. Ltd.	A3
Alcan-Enfield Alloys Ltd.	E10
Alderney Electricity Ltd.	C4
Aldhouse Milnes Ltd.	A2
Aldis Brothers Ltd.	P9
Alexander Controls Ltd.	C10
Alkaline Batteries Ltd.	C3
Alklum Storage Batteries Ltd.	C3
Allan, James (Glasgow) Ltd.	C7
Allan, Jas., & Co. (Aberdeen) Ltd.	C7
Allen, F. W. (Bristol) Ltd.	S7
Alorite Ltd.	D2
Alpha Accessories Ltd.	E4
Amalgamated Electric Corpn. Ltd. (Canada)	G3
Amar Tool and Gauge Co. Ltd.	P6
Ambassador Radio and T.V. Ltd.	C2
American Tradair Corpn. (New York)	C8
Anglo-Great Lakes Corpn. Ltd.	P3
Ardente Ltd.	E4
Ardmore & Beechwood (Belgique) S.A.	E4
Argosy Radiovision Ltd.	L3
Arrow Switches (Australia) Pty. Ltd.	A10
Ascot Lamps and Lighting Ltd.	R1
Ashworth, Thomas, and Co. Ltd.	B14
Associated Automation Ltd.	E8
Associated Electrical Industries Ltd.	R5
Associated Office Machines Ltd.	G1
Associated Transistors Ltd.	A11, E11
Aston Chain & Hook Co. Ltd.	E10

Astral Switchgear Ltd. A9
A.T. & E. (Bridgnorth) Ltd. A11
Atkins, Robertson & Whiteford Ltd. S1
Atlas Lighting Ltd. T4
Atomic Power Constructions Ltd. C16, R6
Aurora Lamps Ltd. J2
Austin Clarke (London) Ltd. T4
Austin Hoy and Co. (Holdings) Ltd. M3
Austin Lifts Ltd. M2
Austinlite Ltd. S8
Australian and NZ Elect. Ind. (Pty.) Ltd. B8
Australian Electrical Industries Ltd. A10
Auto Diesels Ltd. B5
Automatic Controls Ltd. R3
Automatic Telephones (S.A.) Ltd. A11
Automation Systems and Controls Ltd. E12
Avo Ltd. M5

Baker, P. W. and Sons Ltd. B11
Baldwin Central Products Ltd. C2
Baldwin Durawire Cable Co. Ltd. C2
Baldwin Engineering Equipment Ltd. C2
Baldwin, H. J., of Canada Ltd. C2
Baldwin Instrument Co. Ltd. H5
Balfour Beatty and Co. Ltd. P8
Barker & Allen E10
Bartles (Carn Brea) Ltd. B10
Barton Conduits Ltd. B1
Bastian & Allen Ltd. P1
Battery Carbons Ltd. E14, A10, G3
Batwin Electric Motors Ltd. L5
Beadle, T. & Co. Ltd. E1
Beam-Echo Ltd. T4
Beam Instruments Corpn. Inc. U.S.A. C12
Beck & Co. (Meters) Ltd. H7
Belfast Cables Ltd. R4
Bell Engineering (Slough) Ltd. H5
Bennie, John, Ltd. M2
Bepco Canada Ltd. C16, H4, M5
Berec International Ltd. E14
Bessbrook Products Ltd. U1
Best Products Ltd. C12
Beswick, Kenneth E., Ltd. M4
Birka Regulator, G.m.b.H. A10
Birkbys Ltd. A11
Birlec-Efco (Melting) Ltd. A10
Birlefco-Lindberg Ltd. A10
Bishop, P. T., & Co. Ltd. B7
Black Automatic Controls Ltd. E8
B.O.B. (Arundel) Ltd. P5
Bolton, Thomas, & Sons Ltd. B10
Bonar Long & Co. Ltd. L6
Bond, V. C., and Sons Ltd. C8
Bookers Lighting and Radio Ltd. S7
Booth, John, Foundries Ltd. D2
Botwoods Limited M1
Bowler and Sidney Ltd. B5
Branch Properties Ltd. G3
Brand, R. A., (Holdings) Ltd. M4
Bray, E. N., Ltd. U2
Bray, Markham and Reiss Ltd. E5
Brimar Ltd. T4
Bristol Electrical Distributors Ltd. C5
Bristol's Instrument Co. Ltd. E8
Britannia Batteries Ltd. C3
Britannia Engineering Co. A8
Britannic Cables Ltd. G2
British Aircraft Corporation E11
British Automatic Telephone & Electric Pty Ltd., Australia A11
British Batteries Overseas Ltd. C3
British Capeheart Corpn. Ltd. G4
British Centralab Ltd. S2
British Communications Corporation Ltd. R2
British Copper Refiners Ltd. B10
British Dielectric Research Ltd. B10
British Electric Transformer Co. Ltd., The C16
British Klockner Switchgear Ltd. D2
British National Electrics Ltd. J2
British Power Transformer Co. Ltd. B8
British Radio Corpn. Ltd. T4
British Rototherm Co. Ltd., The M4
British Sealed Beams Ltd. A10
British Short Circuit Testing Station Ltd. R5
British Telecommunications Research Ltd. A11, B10
British Vacuum Flask Co. Ltd. S2
Broadmead Ltd. F3
Brookhirst Igranic Ltd. M5
Browns (Llandudno) Ltd. T1
Brown, Neville, & Co. Ltd. P9
B. & R. Relays Ltd. G1
Brush Electrical Engineering Co. Ltd. H8
Bryce Elect. Const. Co. Ltd. H1
Bryce Ltd. H1
B. & S. Electrical Pty. Ltd. C16
Bullers Ltd. A5
Burco Ltd. B14
Bushing Co. Ltd. G3, R5
BVC Industries (NI) Ltd. G4

Cable Jointers Ltd. M5
Cambridge Works Ltd. P10
Canadian Marconi Company E11
Canmar Investment Co. Ltd. E11
Capitol Records Inc., U.S.A. E4
Carlyle Air Conditioning & Refrigeration Ltd. S8
Carrick Eng. (Stewartson) Ltd. S4
Carrick Trust Ltd. C7
Carrington Manufacturing Co. Ltd. P10
Cathodeon Ltd. P10
Cawkell Research and Electronics Ltd. S2
CCA (Finance) Ltd. B16
Ceramic Engineering Co. Ltd. E14
Chain Store Finance Trust Ltd. S7
Chamberlain and Hookham Ltd. G3
Champion Electric Corpn. T4
Chemical & Carbon Products Ltd. E14
Chloride Batteries Ltd. C3
Chrestien, F. F., & Co. Ltd. A10
Christy & Norris Ltd. C4
Churchouse, C. M., Ltd. C14
Civic Radio Services Ltd. F3
Clare, C. P., Ltd. E8
Clark, Geo. (Sunderland), Ltd. R6
Clarke, L., & Co. Ltd. C16
Clarke [illegible] Smith Manufacturing Co. Ltd. E4
Claud[illegible] neral Neon Lights Ltd. G3
Claytat Ltd. E5
Clearex Products Ltd. S2
Clyde Engineering & Equipment Co. Ltd. S1
Clydesdale Rentals Ltd. C7

Clydesdale Television & Radio Co. Ltd. C7
Coldair Ltd. G3
Collier and Beale Ltd. (NZ) G3
Collier, J. F., and Co. Ltd. P2
Columbia Gramophone Co. Ltd. E4
Columbian-General Blacks Ltd. G3
Combined Radio and Television Services Ltd. L3
Combined Telephone Holdings Ltd. P5
Commercial X-Rays Ltd. M4
Commercial Facilities Ltd. C8
Communications (Air) Ltd. C12
Communication Systems Ltd. A11
Compagnie Industrielle des Piles Electriques E14
Companhia Marconi Brasiliera E11
Computer Developments Ltd. G3
Connollys (Blackley) Ltd. B10
Contactor (Pty) Ltd. E8
Control Heating Units (London) Ltd. B13
Contropanels Ltd. S1
Conveyancer Fork Trucks Ltd. E7
Conveyancer Scott Electric Vehicles Ltd. E7
Cooke & Ferguson Ltd. C16
Coolers and Venders Ltd. C2
Corran Works Ltd. P10
Correx Communication Equip. (1948) Ltd. P5
Cossor Radio and Television Ltd. P4
Cottage Laboratories Ltd. P6
Coventry Factors Ltd. C11
Cox, Stanley, Ltd. P9
Crabtree, J. A., and Co. Ltd. C14
Cressall Mfg. Co. Ltd. E17
Creston Electric Ltd. C2
Crittall, Richard, Marine Ltd. C15
Crypto Ltd. M5
Crypton Equipment Ltd. M5
Cryselco Ltd. G3

Daimon G.m.b.H. E14
Dallas, John E., and Sons Ltd. K3
Datum Metal Products Ltd. E12
Deutsche Atlas G.m.b.H. T4
Diesel Equipment Ltd. B5
Dishmaster (London) Ltd. K4
Davey & Moore Ltd. E4
Dawe Instruments Ltd. S2
Dean, W. H. and Son Ltd. B14
Dean Sales Promotion Ltd. B14
Derby Cables Ltd. C16
Designs and Installations Ltd. S4
District Supplies Ltd. S7
Donvin-Dumar Ltd. P9
Douglas (Kingswood) Ltd. W2
D.P. Battery Co. Ltd. C3
D.R. Illuminations Ltd. A2
D.S. Plugs Ltd. D2
Duncan Watson (Elec. Eng.) Ltd. P8
Duran, A. S., and Co. Ltd. C13
Duratube and Wire Ltd. C2
Dynamo & Motor Repairs Ltd. M5
Dynaport Radio & Television Ltd. S7
Dynatron Radio Ltd. C8

E-A Automation Systems Ltd. E8
Eagle Electrical Co. (Bedford) Ltd. K1
Eastnor Electric Co. Ltd. C9
ECC Holdings (Pty) Ltd. E3
Ediswan-Ekco (Aust) Pty Ltd. C8
Ediswan-Ekco (C.R.T.) Co. Pty. Ltd. A10
Edmundsons Electrical Wholesalers Ltd. E1
Edmundsons (Midlands) Ltd. E1
Egacon Fittings Ltd. C5
Egen Electric Ltd. C8
Ekco Electronics Ltd. C8
Ekco-Ensign Electric Ltd. C8, T4
Electrical Division of Radiation Ltd. R1
Electramaid Ltd. B16
Electrical Ohms Ltd. C7
Electric Furnace Co. Ltd. E2
Electrical Screw Ltd. H5
Electric and Ordnance Accessories Co. Ltd. A5
Electric Products Ltd. B8
Electrix Ltd. L1
Electro-Chemical Eng. Co. Ltd. E2
Electroflo Meters Co. Ltd. E8
Electro Mechanical Manufacturing Co. Ltd. Y1
Electro Methods Ltd. E12
Electronic Instruments Ltd. C1
Electronic Reproducers Ltd. C2
Electro-Plastics Ltd. K4
Elgar Research Laboratories Ltd. T4
Elliott Brothers (London) Ltd. E8
Elliott Domestic Appliances Ltd. E9
Elliott Nucleonics Ltd. E8
Ellis & Nort Ltd. H3
Emerson Radio of Canada Ltd. E11
Enclosed Motor Co. Ltd. L2
Enfield Cables Ltd. E10
Enfield Copper Refining Co. Ltd. E10
Enfield-Standard Power Cables Ltd. E10, S5
Enfield Tool Manufacturing Co. Ltd. A11
Enfield Zinc Products Ltd. E10
Engineering Rentals Ltd. S1
English Salvi Co. Ltd. E10
Ensign Lamps (Aust) Pty Ltd. T4
Epsylon Industries Ltd. S8
Escott Brothers Ltd. F3
Essay Electrical Co. Ltd. P8
Ether Ltd. E12
Eugene Munsell & Co. A10
Eureka Conduits Ltd. W1
Evansville Cabinet Co. Ltd. T4
Evenlite Tube Lamp Developments Ltd. G3
Everett Edgecumbe Ltd. B2
Express Lift Co. Ltd. G3

Fairbanks Whitney Corporation US E4
Fairfield Electric Wire Co. Pty. Ltd. A10
Falco Electrical Appliances Ltd. A6
Falkirk Iron Co. Ltd. A6
Faraday Electronic Instruments Ltd. P10
Farris Engineering Ltd. E8
Fawcett Preston & Co. Ltd. M5
Ferguson Radio Corpn. Ltd. T4
Ferranti Radio and Television Ltd. C8
Feress, J. S., Ltd. W3
Ferrostatics Ltd. C3
Fielden Electronics Ltd. H10
Firth Cleveland Instruments Ltd. F3
First Electric Corporation of South Africa Ltd. A10
Fisher Governor Co. Ltd. E8
Fleet Electrics (Retail) Ltd. S10
Flinders (Wholesale) Ltd. E6

Floyd and Partners (Cables) Ltd. C12
Ford Wholesale Electric Ltd. F4
Forrest, Geo., & Son Ltd. T4
Foster Electrical Supplies Ltd. M5
Foster Transformers Ltd. M5
Francis Street Properties Ltd. G1
Fraser and Chalmers of Canada Ltd. G3
Fuller Electric Ltd. H8
Furse Wholesale Ltd. E16
Furse, W. J., & Co. Ltd. E16

Garrard Eng. & Mfg. Co. Ltd. P6
Gilder, Lewis, and Co. Ltd. B10
Gillone Electric Ltd. K2
Gilmoor Control Systems Ltd. E8
Glass Bulbs Ltd. A10, G3
Globelite Industries Ltd. S4
Glover, W. T., and Co. Ltd. B10
GMP Ltd. M2
Gnome Electric Lamp Works, The, Ltd. B6
Gordon, James, & Co. Ltd. E8
GPA Tools and Gauges Ltd. G3
Gramophone Co. Ltd., The E4
Gramophone Co. of Pakistan Ltd., The E4
Grey, S., and Co. (1939) Ltd. S7
Greencoat Electronics Ltd. G1
Gresham & Craven Ltd. W2
Greyfriars Vehicle Contracts Limited M1
Grierson Ltd. C15
Grundig (Great Britain) Ltd. G1
Grundig Works (Northern Ireland) Ltd. G1
Gulf Radiators Ltd. P7

Hackbridge Cable Co. Ltd. H1
Hackbridge Electric Construction Co. Ltd. C9
Hackbridge & Hewittic Electric Co. Ltd. C9
Hackney, A. G., & Co. Ltd. W1
Hadrill and Horstmann Ltd. S2
Hagan Controls Ltd. P6
Hall Electric Ltd. G5
Hallikainen Instruments Ltd. E8
Hall, J., & E. Ltd. H2
Hall Telephone Accessories Ltd. E8
Hard Metals Pty. Ltd. A10
Harland, Vivian Eng. Co. (Pty.) Ltd. H4
Hartley Electromotives Ltd. J1
Hartley Installations Ltd. C2
Harvey and Longstaffe Ltd. C9
Hartley Robertson Ltd. J1
Hawkins, L. G., & Co. Ltd. P10
Hayward Tyler & Co. Ltd. S8
Heatley & Gresham Ltd. W2
Hellermann Ltd. B4
Henley Cables (India) Ltd. A10
Henley Foundries Ltd. A10
Henley-Simplex (Pty.) Ltd. A10
Herrmann, N., Ltd. T4
Hewins, H., Ltd. W2
High Duty Alloys Ltd. H8
Hindustan Klockner Switchgear Ltd. D2
Hivac Ltd. A11
Hobbs Transmission Ltd. W2
Holbrooks Foundry Ltd. K4
Hollingsworth Printing Co. Ltd. P10
Holloway Engineering Works Ltd. P10
Holloway Metal Roofs Ltd. E10
Holmes, J. H., and Co. Ltd. R5
Holsun Batteries Ltd. C3
Home Maintenance Ltd. E4
Horstman Ltd. S2
Howarth, G. L., and Co. Ltd. B14
Humber Graving Dock & Eng. Co. Ltd. R6
Hurseal Ltd. P7
Hymatic Engineering Co. Ltd. C3
Impervious Stone Co. Ltd. P8
Implitico Ltd. S9
Industrial Fan and Heater Co. Ltd. S2
Industrial Reels Ltd. B10
Inglis, John, Co. Ltd. E11
International Power Transformers Ltd. B8
International Rectifier Co. (Gt. Britain) Ltd. M5
Interohm Electrical Insulators Ltd. E5
Invicta Radio Ltd. P10
Ionlite Ltd. F1
Irish Cables Ltd. F1
Irish Overseals Ltd. U1
Irvine, J. F., and Co. Ltd. E6
Irwin, E. G., & Partners Ltd. G1
Isenthal and Co. Ltd. D4
Isotope Developments Ltd. E8
I.T.D. Ltd. C16
Ivor Power Speciality Co. Ltd. A1

Jackson Industries Ltd. R1
Johnson British Electric Ltd. G1
Johnson, W. H., and Sons Limited M1

Kartret Switchgear Co. Ltd. C9
Kego Electric Company Ltd. G5
Kelly Acoustics Ltd. C2
Kelly and Shiel (Ekco Prod.) Ltd. (Dublin) C8
Kelvin Construction Co. Ltd. H8
Kelvin and Hughes Ltd. S3
Kelvin Metal Industries Ltd. H1
Kelvin Non-Ferrous Metal Co. Ltd. H1
Kerr, Dick, and Co. Ltd. E11
Kersons Mfg. Co. Ltd. M6
Ketay Ltd. P6
Kilpatrick, James, and Son Ltd. P8
Kingsway of London Ltd. G1
Klaxon Ltd. A8
Kolster-Brandes Ltd. S5
Kruger-Wilson Africa Ltd. C8
K.S. Construction Co. Ltd. C6

Labgear Ltd. P10
Lamp Caps Ltd. A10, G3
Lamp Prescaps Ltd. T4
Lancashire Dynamo & Crypto Ltd. M5
Lancashire Dynamo Electronic Products Ltd. M5
Langham Thompson, J., Ltd. E12
Langdon, R. F., and Partners Ltd. S2
Lester Plastics Ltd. S2
Leigh Electronics Developments Ltd. P6
Leisure Kitchen Equipment Ltd. A6
Levine, B. M., Ltd. C7
Lewcos (Australia) Pty. Ltd. A10
Leybold-Elliott Ltd. E8
Lighting Trades & Welsbach Ltd. F1
Limit Engineering Group Ltd. C2
Lindley Thompson Transformer & Service Co. Ltd., The P10

Line Equipment Ltd. B4
Llewelyn's Electrical Ltd. S10
Lloyds (Manchester) Elec. Industries Ltd. L3
LMK Mfg. Co. Ltd. S2
London Colney Service Station (1947) Ltd. S2
London Electric Wire Co. and Smiths Ltd. A10
London Transformer and Products Ltd. H1
London Zinc Mills Ltd. E10
Long & Crawford Ltd. L3
Lumenated Ceilings Ltd. H2
Lumifax Ltd. G3
Lundberg, A. P., and Sons T7
L. W. (Houses) Ltd. H1

McLaren Fabrications Ltd. H8
Magnetic Valve Co. Ltd. C15
Machine Products Ltd. P6
Machlett X-Ray Tubes (G.B.) Ltd. G3
Magneta (B.V.C.) Ltd. G4
Magnetic & Electrical Alloys Ltd. B10
Malcolm and Allan Ltd. S1
Malcolm & Allan (London) Ltd. M5
Maldon Woodwork Ltd. C8
Magnetic Devices Ltd. P10
Mallory Batteries Ltd. E14
Manifold Machinery Co. Ltd. T4
Manlove, Alliott and Co. Ltd. M4
Mansbridge Condenser Co. Ltd. D4
Marconi Instruments Ltd. E11
Marconiphone Co. Ltd. E4
Marconi's Wireless Telegraph Co. Ltd. E11
Marris's (Engs.) Ltd. M2
Marryatt and Place Ltd. M2
Marryat's East Africa Ltd. M2
Marshall, F. H. and Co. Ltd. T4
Martin, W. E., & Co. Ltd. E10
Mason, Ronald, Ltd. C7
Mastermet Ltd. E9
Mawdsley's Ltd. S4
Max-Stone Ltd. F3
Maybaum-Richards Verkaufsgesellschaft m.b.h. E4
Mayfair Engineers and Platers Ltd. K4
McColl Electric Works Ltd. (Australia) E3
McCulloch & Young Ltd. C7
McDowell, Thomas, Ltd. C15
McGee, Walter, and Son Ltd. L2
McKenzie & Holland (Australia) Pty. Ltd. W2
M. & C. Switchgear Ltd. M3
Measurement Eng. Ltd. (NZ) P1
Measuring Instruments (Pullin) Ltd. P9
M.E.C. Coolants Ltd. S2
M.E.C. Transmissions Ltd. S2
Mechanical Automation Ltd. E8
Melbray Ltd. M4
Mersey Cable Works Ltd. T7
Metallic Seamless Tube Co. Ltd. T7
Metalectric Furnaces Ltd. I3
Metal Industries Europe S.A. M5
Metro-Cutanit Ltd. A10
Metropolitan Construction Co. Ltd. P8
Metropolitan-Vickers-Beyer, Peacock, Ltd. A10
M.I. Australia Pty Limited M5
Micalectric Ltd. H5
Micanite and Insulators Co. Ltd. A10
Midland Electric Installation Co. Ltd. D1
Millett, Levens (Engravers) Ltd. A10
Minerva Mouldings Ltd. M5
Mirrless, Bickerton & Day Ltd. H8
Mitcham Motor Co. Ltd. H1
Modern Machine Tools Ltd. G1
Monninger, C. D., Ltd. H5
Mono Cam Ltd. S2
Morphy-Richards Ltd. E4
Morris, B. O. (Holdings) Ltd. H5
Mortimer Engineering Co. Ltd. E9
M-O Valve Co. Ltd. G3
M.S.S. Recording Co. Ltd. B10
Mullard Ltd. P4
Multi-Broadcast (Rentals) Ltd. A10
Multisignals Ltd. C
Murdoch and Brooks Ltd. (Iraq) P8
Musica Argentina e Internacional SRL E4
Mysore Electrical Industries Ltd. M5

Nadex Ltd. B14
Napier, D., & Son Ltd. E11
Napier Engineering Inc. E11
Nash and Thompson Ltd. T4
National Automatic Machines Ltd. E8
National Ekco Radio and Eng. Co. Ltd. C8
National Gas and Oil Engine Co. Ltd., The H8
NCL Distributors (Electrical) Ltd. C11
Neckar Water Softener Co. Ltd. A1
Neptune Brass & Aluminium Ltd. A1
Nettle Accessories Ltd. A2
Newcombe, F. D., and Co. Ltd. E6
New Endeavour Engineering Ltd. G5
New Era Electrical Manufacturers Ltd. A10
Newey and Eyre Ltd. T5
Newhaven Cabinet Works Ltd. T4
Newman Electric Motors Inc. N1
Newmarket Electrical Distributors Ltd. C5
Newmarket Transistors Ltd. P10
New Switchgear Construction Co. Ltd. C9
NGN Electrical Ltd. F2
Noma Electric Co. Ltd. B6
Norman and Industrial Marine Engine Co. Ltd. B5
Norstel & Templewood Hawksley Ltd. H8
North-Eastern Marine Eng. Co. Ltd. R6
Noyes Brothers Pty. Ltd. C16
N.S.F. Ltd. S2
Nuclear Graphite Ltd. A10
Nuclear Power Plant Co. Ltd. P3
Nucleonic Investments Ltd. A10

Oriental Tube Co. Ltd. G3
Ottermill Switchgear Ltd. D3

P. & E. Holdings Pty. Ltd. K4
Painter Bros. Ltd. B10
Pamphonic Reproducers Ltd. P10
Pam (Radio & Television) Ltd. P10
Panellit Ltd. E8
Parkhall Pottery Co. Ltd. G3
Parkinson, F. & A., Ltd. C16
Parlophone Co. Ltd. E4
Parnall (Yate) Ltd. R1
Parolle Electric Plant Co. Ltd. P3, R5

Parson, A. R., and Co. Ltd. S2
Parsons, C. A., and Co. Ltd. R5
Parson Marine Turbine Co. Ltd. R6
Parsons, Sir Howard Grubb, and Co. Ltd. P3
Partridge Wilson & Co. Ltd. W2
Patent Lighting Co. Ltd. R4
Patterson Lamps (1953) Ltd. C3
Peerless & Ericsson Ltd. K4
Perihel Ltd. K5
Perivale Motors Ltd. H9
Permaheat (Mossley) Ltd. M7
Petters Ltd. H8
Philco GB Ltd. T4
Phoenix Appliances Ltd. P5
Phoenix Dynamo Manufacturing Co. Ltd. E11
Pirelli-General Cable Works Ltd. G3
Plastic Tubes and Conduit Co. Ltd. C12
Platt-Schindler Lifts Ltd. S8
Playle of Maldon Ltd. C4
Plyglass Ltd. G1
Pope's Electric Lamp Co. Ltd. G3
Power Auxiliaries Ltd. P6
Power Cables of Australia (Pty.) Ltd. A10
Power Centre Co. Ltd. T7
Power Construction Ltd. M5
Precision Engineering Products (Suffolk) Ltd. A11
Precision Plastics Ltd. G1
Preformations Ltd. P6
Preformed Line Materials (Great Britain) Ltd. R7
Premier Lift and Escalator Co. (Pty.) Ltd. G3
Prince, A., Industrial Products Ltd. C2
Printed Circuits Ltd. A10
Printing and Paper Drives Ltd. L2
Private Telephone and Electric Co. Ltd. P5
Pritchett Gold and EPS Co. Ltd. C3
Process Control Gear Ltd. E5
Progressive Electrics Ltd. G3
Pullin Optical Co. Ltd. P9
Pye, W. G., & Co. Ltd. P10

Quartons (Holdings) Ltd. M4

Radio Corpn. of America W2
Radio Gramophone Dev. Co. Ltd. L3
Radio & Television Services Ltd. P10
Railway Signal Co. Ltd., The W2
Rashleigh Phipps Ltd. A7
Rawplug Products (Canada) Ltd. R3
Raydex Ltd. F1
Ray Electricals (Folkestone) Ltd. S6
Reason Manufacturing Co. Ltd. A4
Record Electrical Co. Ltd. E15
Refrigeration Appliances Ltd. E10
Regentone Products Ltd. L3
Regentone Radio and Television Ltd. L3
Reliance Cords and Cables Ltd. R4
Reliance Electrical Co. Ltd. I1
Reliance Telephone Co. Ltd. G3
Reliance T.V. Service Ltd. S10
Remax Ltd. S2
Resoid Ltd. S4
Revo Electric Co. Ltd. D5
Rheostat Company Ltd., The E8
Richardson, H. G., & Co. B1
Ridgers, P. A., Ltd. S10
R.J.S. Services Ltd. C13
Robbins and Bradley Ltd. C14
Rola Celestion Ltd. T6
Rosite Ltd. P6
Ross, Courtney and Co. Ltd. S4
Rotameter Manufacturing Co. Ltd. E8
Rothwell, J. T., and Co. Ltd. G3
Rotosigns Ltd. P5
Rotunda Ltd. B10
Rowe Automatic Merchandising Co. Ltd. C2
Rowland Ltd. C7
Royce Electric Furnaces Ltd. E2
Rozalex Ltd. C3
Russell Construction Ltd. (Canada) P8
Russell Newbury & Co. Ltd. L1
Rustyfa Ltd. C16, M5
Ryecroft Electric Ltd. A2

SA Astar (Argentina) T3
Salford Electrical Instruments Ltd. G3
Sankey-Telcon Ltd. B10
Santon (Wholesale) Ltd. E6
Sauter Controls Ltd. E8
Savage, W. Bryan, Ltd. P10
Saxby & Farmer (India) Private Ltd. W2
Scanners Ltd. E11
Scottish Cables Ltd. B10
Security Electric Pty. Ltd. (Australia) C16
Selecta Power Tools Ltd. E9
Semiconductors Ltd. P6
Siemens Schuckbert (GB) Ltd. H1
Shires and Co. (London) Ltd. C3
Shoolbread Electrical Co. Ltd. D1
Sidney Hole's Electric Vehicles Ltd. H5
Siemens Edison Swan (Pty.) Ltd. A10
Siemens & General Electric Railway Signal Co. Ltd. A10, G3
Simplus Products Ltd. S2
Simm's Motor Units Ltd. S2
Simon Equipment Ltd. H4
Simplex Dairy Equipment Co. Ltd. G3
Simplex Electric Co. Ltd. T7
A/S Skaland Grafitverk (Norway) E14
Sleeper, C. E., Ltd. G6
Smart & Brown (Machine Tools) Ltd. G1, T4
Smith and Ansell Ltd. F1
Smith's Aircraft Instruments Ltd. S3
Smith's Industrial Instruments Ltd. S3
Smith's Switchgear Ltd. B3
Societe Anonyme la Thermostatique E8
Societe d'Equipemente Industrial Electro-mecanique A10
Societe d'Usinage de Materiel Electrique A4
Societe Francaises des Thermostats SA B11
Southampton Electrical Distributors Ltd. C5
Southern Hardware Factors Ltd. F4
Southern United Telephone Cables Ltd. A10, B10
South Wales Electric (Pty) Ltd. A1
South Wales Switchgear Ltd. A1
Spembly Ltd. H5
Sprague Electric Co. T2
Stanley Eng. Co. Ltd. H5
Statter, J. G., & Co. Ltd. M5
Steatite & Porcelain Products Ltd. I2
Stella Lamp Co. Ltd. P4
Stella Radio and Television Co. Ltd. P4

Stenor Ltd. F3
Stent Precast Concrete Ltd. P8
Stephenson, Robert, and Hawthorns Ltd. E11
Sterling Electric Holdings Ltd. L1
Sterling Engineering Co. Ltd. L1
Sterling Incandescent Co. Ltd. L1
St. Helens Cable & Rubber Co. Ltd. B10
Stone-Chance Ltd. S8
Stone, J. & Co. (Deptford) Ltd. S8
Stone, W. H., and Co. (Cardiff) Ltd. E1
Stoves Ltd. F1
Sterling Cable Co. Ltd. C12
Strathlea Investment Ltd. R4
Sturrick Power Installations Ltd. L6
Submarine Cables Ltd. A10, B10
Summerscales, W. S., Ltd. G4
Sumo Pumps Ltd. S8
Sunimac Ltd. M5
Sunvic Regler G.m.b.H. A10
Superpila S.p.A. (Italy) E14
Suter Electrical Engineering Co. Ltd. E13
Svenska Radio Atkiebolaget E11
Swartwout Co. Ltd. E8
Swedish S.A.A.B. Aircraft Co. E4
Swift, B. & P., Ltd. E8
Switchboards Ltd. E5
Switchgear & Cowan Ltd. C9
Switchgear Equipment Ltd. F1
Switchgear Testing Co. Ltd. A10
Sykes and Harrison Ltd. C9
Sykes, W. R., Interlocking Signal Co. W2
Sylvania Thorn Colour Television Labs. T4

Talent Furniture Ltd. T4
Tappan Co. (US) T3
Tate Engineers Ltd. B4
Taylor Electrical Instruments Ltd. M5
Taylor Tunnicliff and Co. Ltd. A5
Tec Ltd. C7
Technical Ceramics Ltd. P6
Teddington Autocontrols Ltd. B11
Teddington Industrial Equipment Ltd. B11
Telcon-Magnetic Cores Ltd. B10
Telcon Metals Ltd. B10
Telecommunications Ltd. U1
Telefonos Automaticos y Productos Electricos S.A. Argentine A11
Telegraph Condenser Co. Ltd., The B10
Telegraph Construction & Maintenance Co. Ltd., The B10
Telephone Manufacturing Co. Ltd. P10
Telephone Manufacturers of South Africa (Pty) Ltd. A10, A11
Telephone Supplies Ltd. G3
Tellux Ltd. K5
Temco Ltd. B10
Tersons Ltd. P8
Thermic Heating Co. Ltd. C15
Thermionic Products (Electronics) Ltd. R2
Thomas, Bertram (Engineers) Ltd. C9
Thompson, R. E., and Co. (Sunbury) Ltd. B13
Thompsons Manufacturing Co. Ltd. S2
Thor Appliances Ltd. R1
Tinsley (Industrial Instruments) Ltd. E15
T. M. C. Harwell (Sales) Ltd. W3
Toolpro Ltd. B10
Trade Development Finance Ltd. F4
Transformers (Watford) Ltd. L4
Treforest Electrical Services Ltd. A1
Tricity Cookers Ltd. T4
Tri-Com Patents Ltd. L2
Truvox Ltd. T6
Tucker, J. H., and Co. Ltd. M6
Tudor Accumulator Co. Ltd. C3
Tuscan Engineering Ltd. H7
T/V Manufacturing Ltd. P10
Tweedales & Smalley Ltd. S8
Twentieth Century Electronics Ltd. C8
Tyer and Co. Ltd. S4
Tyler & Freeman Ltd. S9
Tyseley Foundry Ltd. E3

Unicam Instruments Ltd. P10
Unidare Ltd. P10
Ultimate-Ekco (NZ) Co. Ltd. C8
Unidare Eng. Ltd. U1
United Components Ltd. L3
United Ebonite and Lorival Ltd. C3
United Electrical Co. Ltd. F1
United Insulator Co. Ltd. T2
United Rentals Ltd. P10

Vactite Wire Company A10
V.C.S. (Finance) Ltd. B16
Veedip Ltd. B10
Vending Supply and Service Ltd. C2
Venner Electronics Ltd. V1
Vent-Axia Ltd. H2
Veritas Heating Products Ltd. F1
V.G. Porcelain Co. Ltd. A9
Victoria Machine Tool Co. Ltd. E9
View Rentals (City) Ltd. S10
Volex Electrical Products Ltd. W3
Vulcan Foundry Ltd., The E11

Walsall Hardware Mfg. Co. Ltd. W1
Wandleside Cable Works Ltd. F1
Wandleside Warren Wire Co. Ltd. F1
Waring, Withers and Chadwick Ltd. M2
Warm-Glow Co. Ltd. C8
Watliff Co. Ltd. E10
Watson and Sons (Electro-Medical) Ltd. G3
Watson, W., and Sons Ltd. P10
Webb Conveyors & Automation Ltd. E8
Welded & Allied Products Ltd. L3
Welwyn Electric Ltd. R8
Western Electric Co. Inc. W2
Weston, T. Stanley, Co. Ltd. E1
West Wales Trading Co. (Milford Haven) E1
Wheeler Engineering Co. Ltd. F4
Wheeler, F. H., & Co. Ltd. K5
Whiffen, Richard, Ltd. C9
Wight, E., & Co. (Muswell Hill) Ltd. K5
Wilcock, E. J., Ltd. D1
Willans and Robinson Ltd. E11
Winsor Engineering Co. Ltd., The S8
Wintronics Ltd. A10
Wireless Telephone Co. Ltd. P6
Witton-James Ltd. G3
Woking Wholesale Electrical Ltd. F4
Wolsey Electronics Ltd. G1
Woodcraft Productions (Cambridge) Ltd. P10
Woods of Colchester Ltd. G3
W. S. Electronics (Prod.) Ltd. K5

Young Accumulator Co. Ltd. C16

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